IEEE P802.11  
Wireless LANs

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| 802.11 HEW Draft PAR and 5C | | | | |
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Abstract

This is a draft PAR and five criteria for IEEE 802.11 HEW Study Group consideration.

R0: document created.

R1: Dec 02/2013 🡪 added text to different sections of the PAR and the 5C.

R2: Dec 26/2013 🡪 moved text in section 5.2a to 5.2b and section 5.4 to 5.5

Dec 26/2013 🡪 changed section 5.2a and 5.4 to include the text from IEEE 802.11 scope and purpose.

R3: Jan 12/2014 🡪 update the PAR sections based on submission 11-14/0013r0 discussed during the telecon 20140108.

Jan 12/2014 🡪 edited the 5C sections based on CC11 comments.

# PAR

**P802.11**

**Submitter Email: osama53@rogers.com**  
**Type of Project:** Amendment to IEEE Standard 802.11-2012  
**PAR Request Date:** TBD  
**PAR Approval Date: March 2014  
PAR Expiration Date: March 2018  
Status:** Unapproved PAR, PAR for an Amendment to an existing IEEE Standard

**1.1 Project Number:** P802.11tbd  
**1.2 Type of Document:** Standard   
**1.3 Life Cycle:** Full Use

**2.1 Title:** Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications-- Amendment: Enhancements for Highly Efficient Wireless LAN

**3.1 Working Group:** Wireless LAN Working Group (C/LM/WG802.11)   
**Contact Information for Working Group Chair**

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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:**2017-July  
**4.3 Projected Completion Date for Submittal to RevCom:**2018-July

**5.1 Approximate number of people expected to be actively involved in the development of this project:** 200

**5.2.a. Scope of the complete standard:** The scope of this standard is to define one medium access control (MAC) and several physical layer (PHY) specifications for wireless connectivity for fixed, portable, and moving stations (STAs) within a local area.

**5.2.b. Scope of the project:**

This amendment defines standardized modifications to both the 802.11 physical layers (PHY) and the 802.11 Medium Access Control Layer (MAC) that enable modes of operation capable of supporting at least two (2) times improvement in the average throughput per station (measured at the MAC data service access point) in dense indoor, and pedestrian-speed outdoor deployment scenarios.

The new standard operates in the 2.5 GHz and 5 GHz frequency bands. The new amendment shall include a mode of operation ensuring backward compatibility and coexistence with legacy IEEE802.11 devices operating in the same bands.  
 **5.3 Is the completion of this standard dependent upon the completion of another standard: NO**

**5.4 Purpose:** The purpose of this standard is to provide wireless connectivity for fixed, portable, and moving stations within a local area. This standard also offers regulatory bodies a means of standardizing access to one or more frequency bands for the purpose of local area communication.

**5.5 Need for the Project:**WLAN devices are currently being deployed in diverse environments. These environments are characterized by the existence of many access points and many stations in geographically limited areas. Increased interference from neighbouring devices gives rise to performance degradation. Additionally WLAN devices are increasingly required to support a variety of applications such as video, cloud access, and offloading. With the real-time performance requirements of some of these applications, WLAN users demand improved reliability in delivering their applications. Unlike previous amendments where the focus was on improving aggregate throughput, this amendment will focus on improving metrics that are affecting user experience, such as average per station throughput, the 5th percentile of per station throughput, and area throughput. Improvements will be made to support environments such as wireless corporate office, outdoor hotspot, dense residential apartments, and stadiums.   
 **5.6 Stakeholders for the Standard:**Manufacturers and users of semiconductors, personal computers, enterprise networking devices, consumer electronic devices, home networking equipment, mobile devices, and cellular operators.

**Intellectual Property:  
6.1.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

**7.1 Are there other standards or projects with a similar scope?:**   
No

**7.2 Joint Development**  
**Is it the intent to develop this document jointly with another organization?:** No  
  
**8.1 Additional Explanatory Notes (Item Number and Explanation):**

**5.2.b**

Average throughput per station is directly proprtional to both aggregate throughput and area throughput. To ensure even distribution of throughput among a number of stations in an area, the 5th percentile measure of the per station throughput will also be considered. These metrics, along with the satisfaction of the packet delay and the packet loss requirements of applications, will directly correspond to user experience in identified scenarios.

Since the values of the metrics of interest will depend on the scenario, the focus will be on the relative improvement of these metrics compared to previous IEEE 802.11 amendments (IEEE 802.11n in 2.4GHz and IEEE 802.11ac in 5GHz).

The amendment will be evaluated with a set of typical deployment scenarios representative of the main expected usage models that are likely to suffer bottlenecks in the coming years: residential, enterprise, indoor and outdoor hotspots. HEW SG has initiated the creation of a high-level simulation scenario working document (ref: 11-13/1001r5) to model these scenarios.

These scenarios highlight three categories of objectives to improve WLAN efficiency:

* Efficient use of spectrum resources in scenarios with a high density of STAs per BSS.
* Significantly increase spectral reuse and manage interference between neighboring OBSS in scenarios with a high density of both STAs and BSSs.
* Increased robustness to outdoor propagation characteristics and increase uplink transmission reliability

This project may include the capability to handle multiple simultaneous communications in both the spatial and frequency domains, in both the UL and DL.

This amendment may include modes of operation that improve the power consumption of battery- operated devices.

# Five Criteria

## Broad Market Potential

A standards project authorized by IEEE 802 LMSC shall have a broad market potential. Specifically, it shall have the potential for:

a) Broad sets of applicability.

Cisco’s VNI predicts that Internet traffic will reach zettabytes by the end of 2016. By 2017 traffic of end stations that connect over wireless links will reach 51% of the total traffic.. Traffic growth continues to be driven by significant growth in the video traffic. New uses such as video streaming, simultaneous transmission of multiple high rate video streams, on-line gaming, and cloud access will drive the need for improving system level performance and user experience in the home, enterprise, and outdoor environments.

More individuals increasingly rely on Wi-Fi connections to support their connectivity needs including entertainment, web surfing, and e-commerce. Forecasts from International Data Corporation (IDC) show that 87% of connected devices sales by 2017 will be tablets and smartphones. Those consumer devices are equipped with Wi-Fi interfaces. The use of these devices for video streaming, on-line gaming, and other applications drives an increased traffic volume on Wi-Fi infrastructure.

Similar to the wired Ethernet and the related bridging technology (IEEE 802.3 and IEEE 802.1), the Wi-Fi technology is now finding its way to the carrier domain. Cellular operators are now using Wi-Fi technology for data offloading. Infonetics Research predicts that the carrier Wi-Fi market to reach $2.8B by year 2017, at a 5 year CAGR of 40%. Units will grow from 985K access points (APs) in year 2012 to 5.3M APs in year 2017, a 40% CAGR. Carrier hotspot deployments are expected to reach 5.8M world wide by year 2015. Hotspot deployments are characterized by densly deployed APs to provide sufficient coverage to a large number of devices. Hotspot users are looking for seamless connectivity and a Wi-Fi experience similar to that they receive on the cellular networks.

Enterprises, such as small and medium businesses, are increasingly dependant on Wi-Fi technology as their main networking infrastructure. Network Barometer 2013 report predicts that in the next few years an Enterprise network will be composed of 80% wireless ports and 20% wired ports reversing the current ratio. Improved system performance is a main factor for enterprise to migrate to Wi-Fi technology and to achieve the expected cost saving.

b) Multiple vendors and numerous users.

A wide variety of vendors currently build numerous products for the WLAN marketplace. According to Dell’Oro Group overall Wireless LAN market revenues are forecast to exceed $11 billion in 2017, nearly 50 percent greater than 2012 revenues. It is anticipated that the majority of those vendors, and others, will participate in the standards development process and subsequent commercialization activities.

ABI Wi-Fi chipset forecast estimates that 25% of homes around the world use Wi-Fi in year 2012. . ABI Research expects that the number of devices shipped with Wi-Fi interface to reach 3B by year 2015.

c) Balanced costs (LAN versus attached stations).

1. WLAN equipment is accepted as having balanced costs. The development of Wireless capabilities to enhance the efficiency of WLAN network deployments and improve system level performance will not disrupt the established balance.

## Compatibility

IEEE 802 LMSC defines a family of standards. All standards should be in conformance : IEEE Std 802, IEEE 802.1D, and IEEE 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with IEEE 802.1 Working Group. In order to demonstrate compatibility with this criterion, the Five Criteria statement must answer the following questions.

a)Does the PAR mandate that the standard shall comply with IEEE Std 802, IEEE Std 802.1D and IEEE Std 802.1Q? No.

b)If not, how will the Working Group ensure that the resulting draft standard is compliant, or if not, receives appropriate review from the IEEE 802.1 Working Group?

Compatibility with IEEE 802 requirements will be accomplished by keeping the MAC SAP interface the same as the existing 802.11 standard. The proposed amendment shall introduce no 802.1 architectural changes. The MAC SAP definition shall not be altered, ensuring that all LLC and MAC interfaces are compatible to and in conformance with the IEEE 802.1 Architecture, Management and Internetworking standards. New managed objects shall be defined as necessary in a format and structure consistent with existing 802.11 managed objects.

## Distinct Identity

Each IEEE 802 LMSC standard shall have a distinct identity. To achieve this, each authorized project shall be:

a) Substantially different from other IEEE 802 LMSC standards.

This project will focus on a WLAN that can efficiently support deployments with dense stations and dense access points where interference from neighbouring devices is an issue affecting the perceived user experience. This project will focus on system level performance and improving the utilization of the spectrum resources as well as interference mitigation and management between neighboring OBSSs..

b) One unique solution per problem (not two solutions to a problem).

There is no other wireless LAN standard focusing on significantly improving WLAN efficiency and system level peformance in dense deployment scenarios other than this amendment..

c) Easy for the document reader to select the relevant specification.

Thisamendment will differentiate itself from other IEEE 802 wireless standards via the title which stresses the specification of highly efficient WLAN technology.

## Technical Feasibility

For a project to be authorized, it shall be able to show its technical feasibility. At a minimum, the proposed project shall show:

a) Demonstrated system feasibility.

Candidate technologies that may contribute to achieve the targeted efficiency encompass time/frequency/space/spatial multiplexing. Candidate technologies may include,transmit power control (TPC), multiple simultaneous transmissions in the frequency and the spatial domain such as OFDMA and SDMA, and enhanced beamforing.. These technologies have demonstrated feasibility in the cellular context and are applicable to WLAN.

The IEEE 802.11 HEW SG has reviewed several presentations indicating that the proposed functions are technically feasible:

* <https://mentor.ieee.org/802.11/dcn/13/11-13-1395-02-0hew-simultaneous-transmission-technologies-for-hew.pptx>
* <https://mentor.ieee.org/802.11/dcn/13/11-13-1382-00-0hew-discussion-on-ofdma-in-hew.pptx>
* <https://mentor.ieee.org/802.11/dcn/13/11-13-1388-00-0hew-ul-mu-transmission.pptx>
* <https://mentor.ieee.org/802.11/dcn/13/11-13-1126-00-0hew-beamforming-under-obss-interference.pptx>
* <https://mentor.ieee.org/802.11/dcn/13/11-13-0877-01-0hew-hew-beamforming-enhancements.ppt>
* <https://mentor.ieee.org/802.11/dcn/13/11-13-1487-02-0hew-apartment-capacity-dsc-and-channel-selection.pptx>

For a complete list of presentations, please refer to: <https://mentor.ieee.org/802.11/documents?is_dcn=DCN%2C%20Title%2C%20Author%20or%20Affiliation&is_group=0hew>

b) Proven technology, reasonable testing.

Until the full extent of the user models referenced in the IEEE 802.11 HEW PAR is understood, the study group cannot completely assess the extent of reasonable testing for those technologies. However, IEEE 802.11 is a mature technology which has a wide variety of legacy devices and a proven track record, with several billions of devices shipping each year and the increased capabilities envisioned for the baseband and RF parts necessary to implement the proposed amendment are in line with the current progress in technology.

c) Confidence in reliability.

Analysis of current WLAN products, new academic research, and experience from other wireless technologies provide confidence in the reliability of the technology that will be developed by the project. This project will result in similar or improved reliability over current levels.

d) Coexistence of IEEE 802 LMSC wireless standards specifying devices for unlicensed operation.

The working group will create a CA document as part of the WG balloting process.

## Economic Feasibility

For a project to be authorized, it shall be able to show economic feasibility (so far as can reasonably be estimated) for its intended applications. At a minimum, the proposed project shall show:

a) Known cost factors, reliable data.

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 802.11n and IEEE 802.11ac. The cost factors for these transitions are well known and the data for this is well understood.

b) Reasonable cost for performance.

The new amendment will provide users with improved efficiency by focusing on system level metrics that directly impact user experience, e.g. area throughput, average per STA throughput, and packet delay and loss. In general, the cost factor changes needed to implement the technology envisioned by the study group are well within the capabilities of existing technology. Competition between manufacturers will ensure that costs remain reasonable.

c) Consideration of installation costs

The proposed amendment has no known impact on installation costs. **References:**