IEEE P802.11
Wireless LANs

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| Minutes 802.11 be PHY ad hoc Telephone Conferences, May - July 2020 |
| Date: 2020-05-19 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Sigurd Schelstraete | Quantenna/ON Semiconductor |  |  | Sigurd.schelstraete@onsemi.com |
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Abstract

This document contains the PHY ad hoc meeting minutes for TGbe teleconferences held on:

* May 18th, 2020
* May 21st, 2020

**Monday May 18th, 2020 10:00 – 13:00 ET**

**Introduction**

1. The Chair (Tianyu Wu, Apple) calls the meeting to order at 10:00am ET.
2. The Chair follows the agenda in 11-20/0735r7
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. Nobody speaks up.
4. The following agenda is approved:
	* [608r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0608-00-00be-consideration-on-eht-ltf.pptx) Consideration on EHT LTF (Jinyoung Chun) [2 SPs]
	* [651r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0651-01-00be-further-thoughts-on-eht-ltf-papr-in-802-11be.pptx) Further Thoughts on EHT-LTF PAPR in 802.11be (Genadiy Tsodik) [2 SPs]
	* [666r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0666-02-00be-80mhz-ofdma-tone-plan.pptx) 80MHz OFDMA Tone Plan (Ron Porat) [1 SP]
	* [609r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0609-02-00be-further-discussion-on-ru-allocation-subfield-in-eht-sig.pptx) Further discussion on RU allocation subfield in EHT-SIG (Ross J. Yu) [9 SPs]
	* [652r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0652-00-00be-signaling-of-ru-allocation-in-11be.pptx) Signaling of RU allocation in 11be (Dongguk Lim)
	* [738r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0738-00-00be-evaluation-of-signaling-overhead-for-eht-sig.pptx) Evaluation of signalling overhead for eht sig (Dongguk Lim) [1 SP]
	* [674r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0674-00-00be-forward-compatible-ofdma.pptx) Forward compatible OFDMA (Xiaogang Chen)
	* [767r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0767-00-00be-number-of-users-in-mu-mimo.pptx) Number of users in MU-MIMO (Ron Porat)

* + [773r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0773-00-00be-bcc-interleaver-parameters-for-multiple-ru.pptx) BCC Interleaver Parameters for Multiple RU (Ross Jian Yu)
1. The Chair reminds everyone to report their attendance by sending an e-mail to the Co-chair, Sigurd Schelstraete (Quantenna/ON Semiconductor) or the Chair himself.

**Attendance**

The following people recorded their attendance for this call:

* Abhishek Agrawal (On Semiconductor)
* Song-Haur An (Independent)
* Carol Ansley (Commscope)
* Rui Cao (Nxp Semiconductors)
* Xiaogang Chen (Intel)
* Jinsoo Choi (Lg Electronics)
* Roya Doostnejad (Intel Corporation)
* Ruchen Duan (Samsung)
* Ahmed Elsherif (Qualcomm Incorporated)
* Ming Gan (Huawei Technologies Co., Ltd)
* Lili Hervieu (Cable Television Laboratories Inc. (Cablelabs))
* Lei Huang (Panasonic Asia Pacific Pte Ltd.)
* Chenhe Ji (Huawei Technologies Co. Ltd)
* Feng Jiang (Intel Corporation)
* Oren Kedem (Huawei Technologies Co. Ltd)
* Myeong-Jin Kim (Samsung)
* Sanghyun Kim (Wilus Inc)
* Youhan Kim (Qualcomm Incorporated)
* Wookbong Lee (Samsung)
* Dandan Liang (Huawei Technologies Co., Ltd)
* Dong Guk Lim (Lg Electronics)
* Jianhan Liu (Mediatek Inc.)
* Miguel Lopez (Ericsson Ab)
* Hanqing Lou (Interdigital, Inc.)
* Liuming Lu (Zte Corporation)
* Khashayar Mirfakhraei (Cisco Systems, Inc.)
* Dignus-Jan Moelker (Broadcom Corporation)
* Leo Montreuil (Broadcom Corporation)
* Yujin Noh (Newracom Inc.)
* Stephen Palm (Broadcom Corporation)
* Eunsung Park (Lg Electronics)
* Ron Porat (Broadcom Corporation)
* Srinath Puducheri (Broadcom Corporation)
* Oded Redlich (Huawei)
* Sigurd Schelstraete (Quantenna Communications, Inc.)
* Prashant Sharma (Marvell Semiconductor, Inc.)
* Stephen Shellhammer (Qualcomm Incorporated)
* Shimi Shilo (Huawei)
* Paul Strauch (Qualcomm Incorporated)
* Jung Hoon Suh (Huawei Technologies Co. Ltd)
* Bo Sun (Zte Corporation)
* Bin Tian (Qualcomm Incorporated)
* Genadiy Tsodik (Huawei Technologies Co. Ltd)
* Allert Van Zelst (Qualcomm Incorporated)
* Lisa Ward (Rohde & Schwarz)
* Yan Xin (Huawei Technologies Co., Ltd)
* Aiguo Yan (Oppo)
* Rui Yang (Interdigital, Inc.)
* Steve Ts Yang (Mediatek Inc.)
* Yongjiang Yi (Futurewei Technologies)
* Christopher Young (Broadcom Corporation)
* Jian Yu (Huawei Technologies Co., Ltd)
* Mao Yu (Nxp Semiconductors)
* Yan Zhang (Nxp Semiconductors)

**Strawpolls**

**608r0 Consideration on EHT LTF (Jinyoung Chun)**

SP1:

Do you support to reuse 1/2/4x HE-LTF sequences for 1/2/4x EHT-LTF sequences in 80+80/160MHz?

Discussion:

* Does this impact the length of the sequence?
* A: same tones are used, reuse of existing LTF sequence.

Result:

Y/N/A: 41/0/4

SP2:

Do you support to use a unified sequence for each 1/2/4x EHT-LTF in full bandwidth transmission as well as preamble punctured or RU aggregated transmission in each 20/40/80/80+80/160/240/320MHz?

SP2 is deferred to reconsider support of 240 and 320 MHz

Deferred

**666r2 80MHz OFDMA Tone Plan (Ron Porat)**

SP:

Do you support the following toneplan for 11be 80 MHz OFDMA?
80 MHz OFDMA = 40 MHz DUP, Table 27-8 in 11ax D6 right/left shifted by 256 tones.
Notes: refer to 666r2

Discussion:

* Q: Location of the pilot tones is not specified
* A: same as in HE-40, with shift
* Q: Do the 5 DC tones in HE40 become a guard band?
* A: With the duplication it ends up being a guard band. Easiest way is to duplicate the design of 40.

Result:

Y/N/A: 44/1/5

**609r3 Further discussion on RU allocation subfield in EHT-SIG (Ross J. Yu)**

SP1:

Do you agree to add the following to the 11be SFD:

* 1. An RU Allocation subfield that is present in the Common field of the EHT-SIG field of an EHT PPDU sent to multiple users (except EHT TB PPDU), indicates RU assignment, including the size of the RU(s) and their placement in the frequency domain, to be used in the EHT modulated fields of the PPDU in the frequency domain.
		1. Compressed modes are TBD.

Results:

Y/N/A: 37/0/8

SP2:

Do you agree that the mapping from the TBD-bit RU Allocation subfield to the RU assignment, contains the following entries:

(see 609r3, slide 18)

Discussion:

* Comment: this depends on compression mode. Some modes may have to be removed.
* A: special entries not included here, only small RUs, singe RUs, small RU combinations, other things TBD.
* There is a request to defer after a separate, similar SP is run first
* Comment: more discussion needed on details. Would prefer to also run SP in 373r1 first.
* Several people agree with the “table” approach but want to see further details deferred.

SP2 from 609r3 is deferred

[20/0373r1] SP2:

Do you agree to use RU allocation subfield defined in 11ax to indicate RU to be assigned to each STA for MU PDDU when only one RU per a STA is assigned and the number of multiplexed users in each RU is supported in 11ax?

Discussion

Request to defer.

SP2 from 373r1 is deferred

SP3 (609r3):

Do you agree that when small MRU exists within a 242-tone RU range, MU-MIMO shall not be supported within the 242-tone RU range?

Discussion

* Request to remove MRU
* A: that changes the meaning of the SP
* Q: do you support MU-MIMO on RU106?
* A: same as 11ax
* Q: propose to just poll support of MU-MIMO for RU 242 and above.

SP3 is modified as follows:

SP3a:

* Do you agree that the minimum RU size for EHT to support MU-MIMO shall be 242-tone RU?

Results:

Y/N/A: 31/6/13

SP5 (609r3):

* **Do you agree that for RU484 or RU996, in the RU allocation table, 9 entries per RU size will be used to indicate: contributes 0~8 User fields to the User Specific field in the same EHT-SIG content channel as this RU Allocation subfield?**

Discussion:

* Comment: more time to think about it. Not ready for details. Need to see whole picture.

All remaining SPs in 609r3 are deferred.

Proposal to run high-level SP related to this topic:

[20/0652r0] SP1:

* **Do you agree that the RU allocation subfield in the EHT-SIG field of an EHT-PPDU sent to multiple users includes the RU allocation for Multiple RUs as well as Single RU?**

Discussion:

* Q: does this mean that MRU is indicated by single entry in table?
* A: yes

Result:

Y/N/A: 38/0/10

**738r2 Evaluation of signalling overhead for eht sig (Dongguk Lim)**

SP1:

Do you agree that N RU allocation subfields are present in an EHT-SIG content channel?

Where, N is the number of RU allocation subfield in common field of EHT-SIG content channel.

N = 1 if a 20MHz or 40MHz EHT PPDU sent to multiple users is used.

N = 2 if a 80MHz EHT PPDU sent to multiple users is used.

N = TBD for other cases.

The compressed modes are TBD.

Discussion:

* Q: why not for all BWs?
* A: leave room for discussion for wider BW

Result:

Y/N/A: 38/1/10

**New Submissions**

**674r1 Forward compatible OFDMA (Xiaogang Chen)**

Discussion:

* Comment: this can be naturally supported. No requirement on future generations is necessary.
* Q: How long is time between frames (slide 5)?
* Several people comment that this should also be presented in the MAC or joint session. Presenter will ask for time in the joint session.
* Q: For UL OFDMA, could HE be outside of the P80?
* A: should be transparent to 11ax
* Q: is this for both UL and DL OFDMA?
* A: yes
* Q: need to consider all implications. Moving the LO per-packet could have consequences. Should not be an R1 feature.
* Q: what BW would be signalled for this?
* A: implementation specific.

SP is deferred

**767r0 Number of users in MU-MIMO (Ron Porat)**

Proposes that support of 8 MU-MIMO users is sufficient

Discussion:

* Q: any limits on N\_STS?
* A: already agreed to have a max of 4
* Q: should there be a minimum limit for N\_STS?
* A: no limit needed in spec.

SP:

* ~~Do you support that max 8 users can be scheduled in DL MU-MIMO group per RU/MRU?~~
* Do you agree that the max number of users that can be spatially multiplexed in EHT for DL transmissions is 8 per RU/MRU?
	+ Applicable to all transmission modes in 11be ~~single AP MU-MIMO, as well as AP coordination mode~~

Results:

Y/N/A: 45/1/6

**773r0 BCC Interleaver Parameters for Multiple RU (Ross Jian Yu)**

Discussion:

* Q: in other cases, Ncol is N\_SD/DTM. Want to double check.
* A: OK to defer SP

SP deferred

**693 Aggregated PPDU for Large BW**

SP:

* **Do you agree to define frequency domain aggregation of ~~aggregated~~ PPDUs for EHT?**
	+ Aggregated PPDU consists of multiple ~~sub-~~PPDUs.
		- The ~~sub-~~PPDU format combination limits to EHT and HE.
		- Other combinations are TBD.
		- For the ~~sub-~~PPDU using HE format, the PPDU BW TBD.
		- The number of ~~sub-~~PPDUs is TBD.
	+ A-PPDU will be R2 feature.

Discussion:

* Q: sub-PPDU is level lower than PPDU. Is this terminology correct? “sub” should be removed
* Comment: 11ad has a definition for aggregated PPDU. Should use different term. “Frequency aggregation of PPDUs” is proposed

Results:

Y/N/A: 31/0/7

**Adjourn**

The meeting is adjourned at 12:56 PM ET

**Thursday May 21th, 2020 19:00 – 22:00 ET**

**Introduction**

1. The Chair (Tianyu Wu, Apple) calls the meeting to order at 10:00am ET.
2. The Chair follows the agenda in 11-20/0735r11
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. Nobody speaks up.
4. The following agenda is approved:

	* [608r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0608-00-00be-consideration-on-eht-ltf.pptx) Consideration on EHT LTF (Jinyoung Chun) [SPs]
	* [651r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0651-01-00be-further-thoughts-on-eht-ltf-papr-in-802-11be.pptx) Further Thoughts on EHT-LTF PAPR in 802.11be (Genadiy Tsodik) [2 SPs]
	* [782r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0782-00-00be-eht-stf-sequences.pptx) EHT-STF Sequences (Eunsung Park)
	* [778r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0778-00-00be-mu-mimo-simplifications-for-eht.pptx) MU-MIMO Simplifications for EHT (Sameer Vermani)
	* [783r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0783-00-00be-eht-sig-compression-format.pptx) EHT-SIG Compression Format (Ross Jian Yu)
	* [699r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0699-01-00be-phase-rotation-proposal-follow-up.pptx) Phase Rotation Proposal Follow-up (Eunsung Park) [SPs]
	* [796r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0796-00-00be-mandatory-larger-bw-support.pptx) Mandatory larger BW support for PHY (Ron Porat)
	* [768r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0768-00-00be-further-discussion-about-preamble-puncturing.pptx) Further Discussion about Preamble Puncturing (Oded Redlich)
	* [789r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0789-00-00be-on-tbd-segment-parser-and-tone-interleaver-for-specific-mru.pptx) On TBD segment parser and tone interleaver for specific MRU (Jianhan Liu)
	* [791r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0791-01-00be-mandatory-m-ru-support.pptx) Mandatory M-RU (Ron Porat)
	* [793r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0793-00-00be-mru-support-in-11be.pptx) MRU support in 11be (Jianhan Liu)
	* 798r0 Signaling of RU allocation follow-up (Dongguk Lim)
5. The Chair reminds everyone to report their attendance by sending an e-mail to the Co-chair, Sigurd Schelstraete (Quantenna/ON Semiconductor) or the Chair himself.

**Attendance**

The following people recorded their attendance for this call:

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* Jianwei Bei (Nxp Semiconductors)
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* Xiaogang Chen (Intel)
* Jinyoung Chun (Lg Electronics)
* Rolf De Vegt (Qualcomm Incorporated)
* Roya Doostnejad (Intel Corporation)
* Ahmed Elsherif (Qualcomm Incorporated)
* Vinko Erceg (Broadcom Corporation)
* Hung-Tao Hsieh (Mediatek Inc.)
* Lei Huang (Panasonic Asia Pacific Pte Ltd.)
* Wookbong Lee (Samsung)
* Jialing Li (Qualcomm Incorporated)
* Dong Guk Lim (Lg Electronics)
* Chenchen Liu (Huawei Technologies Co., Ltd)
* Hanqing Lou (Interdigital, Inc.)
* Jun Minotani (Panasonic Corporation)
* Khashayar Mirfakhraei (Cisco Systems, Inc.)
* Leo Montreuil (Broadcom Corporation)
* Takayuki Nakano (Panasonic Corporation)
* Eunsung Park (Lg Electronics)
* Ron Porat (Broadcom Corporation)
* Srinath Puducheri (Broadcom Corporation)
* Rethnakaran Pulikkoonattu (Broadcom Corporation)
* Sigurd Schelstraete (Quantenna Communications, Inc.)
* Shimi Shilo (Huawei)
* Paul Strauch (Qualcomm Incorporated)
* Jung Hoon Suh (Huawei Technologies Co. Ltd)
* Bo Sun (Zte Corporation)
* Bin Tian (Qualcomm Incorporated)
* Genadiy Tsodik (Huawei Technologies Co. Ltd)
* Aiguo Yan (Oppo)
* Rui Yang (Interdigital, Inc.)
* Steve Ts Yang (Mediatek Inc.)
* Yongjiang Yi (Futurewei Technologies)
* Christopher Young (Broadcom Corporation)
* Jian Yu (Huawei Technologies Co., Ltd)
* Yan Zhang (Nxp Semiconductors)

**Strawpolls**

SPs in 608r0 and 651r1 are deferred

**New presentations**

**782r0 EHT-STF Sequences (Eunsung Park)**

Several new proposals for EHT-STF:

* 240/160+80 MHz EHT-STF sequence
* 320/160+160 MHz EHT-STF sequence
	+ Two options

Discussion

Most of the discussion is around the question of whether 320 MHz phases can be reused for 240 MHz (seen as 320 MHz with punctured 80 MHz). The presenter indicates this is possible, although it is not his preference.

Q: some cases for 2x EHT-LTS show higher PAPR. Do these higher PAPR correspond to higher PAPR for data as well.

A: yes

SP2 (782r0)

* **Do you agree to add the following text to the TGbe SFD?**
	+ 1x and 2x 320/160+160MHz EHT-STF sequences are designed by repeating 1x and 2x 160MHz HE-STF sequences, respectively
		- Additional coefficients for phase rotation are TBD

Discussion

Some people believe it’s too early to decide. There also remains the question of harmonizing with 240 MHz.

Deferred

SP3 (782r0)

* **Do you agree to unify the EHT-STF sequence between contiguous and non-contiguous modes for one given BW indicated in BW subfield in U-SIG?**
	+ It is not intended for SFD

Q: Does this mean that same sequence would be used for 240 and 160+80?

A: yes

Q: is it the intention to have one sequence per BW field value

A: yes

Q: not clear whether 240 MHz is a separate PPDU or punctured PPDU

SP is modified to capture that the sequence is based on BW field.

Results

Y/N/A: 34/1/5

**778r0 MU-MIMO Simplifications for EHT (Sameer Vermani)**

11ax allows a lot of flexibility in MU-MIMO. Many of these modes are not implemented.

Proposed simplifications:

* Min PPDU BW for hybrid transmissions is 80 MHz
* Min RU size for MU-MIMO in 80 MHz: RU 242
* Min RU size for MU-MIMO in 160 MHz: RU 242
* Min RU size for MU-MIMO > 160MHz: RU 484

Discussion:

Q: 20 MHz device cannot do MU-MIMO?

A: it can, as part of 80 MHz transmission.

Q: the size of the minimum RU should be up to the AP. Not clear how this simplifies things.

A: number of combinations grow exponentially with # RUs

SP1 (778r0)

* **Do you agree that for EHT PPDUs where MU-MIMO is happening on part of the PPDU BW 80MHz is the minimum PPDU BW ?**
	+ The limitation is also applicable to the case where the PPDU has multiple MU-MIMO RUs which collectively span the entire PPDU BW

Result:

Y/N/A: 25/12/10

Other SPs deferred

**783r0 EHT-SIG Compression Format (Ross Jian Yu)**

In 11ax: compression mode has no common field.

11be: 2 modes proposed

* Full BW MU-MIMO
* Punctures SU or MU-MIMO

Enable compression mode for aggregated PPDU and multi-segment EHT-SIG

SPs deferred

**699r1 Phase Rotation Proposal Follow-up (Eunsung Park)**

Main change: option 4 with alternative phase rotation method (only +/- 1 phase rotation)

SP#7

* **Which phase rotation do you prefer for 320/160+160 MHz PPDU?**
	+ Option 2: repeating conventional 11ax phase rotation and applying an additional binary coefficient to each 80MHz segment
	+ Option 4: alternative phase rotation with binary coefficients
	+ None
	+ Abstains

Note: This is not intended for SFD

Discussion:

Q: focus on 240 and 320 only?

A: phase rotation for 40/80/160 already agreed

Q: Option 2 preferred. Otherwise, legacy devices could be confused.

A: prefer option 2 or 4.

Q: not clear how this affects legacy devices.

Q: It may be necessary to keep the 80 MHz sequence for FTM

Q: is this applied to whole PPDU?

A: only legacy and EHT preamble

Results:

Option2/Option4/None/Abstain: 15/11/2/12