IEEE P802.11  
Wireless LANs

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| Minutes 802.11 be PHY ad hoc Telephone Conferences,  March 2020 | | | | |
| Date: 2020-03-23 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Tianyu Wu | Apple |  |  | tianyu@apple.com |
|  |  |  |  |  |

Abstract

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

* March 23, 2020
* March 26, 2020
* March 30, 2020

**Monday March 23th, 2020 10:00 – 13:00 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, Quantenna/ON Semiconductor) calls the meeting to order at 10:00am ET.
2. The Chair follows the agenda in 11-20/0425r9
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. Nobody speaks up.
4. Discussions on the agenda. Updated presentation list for today:
   * [439r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0439-00-00be-efficient-eht-preamble-design.pptx) Efficient EHT Preamble Design (Jianhan Liu)
   * [402r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0402-00-00be-u-sig-and-eht-sig-contents-discussion.pptx) U-sig-and-eht-sig-contents-discussion (Ross Jian Yu) (Deferred)
   * [474r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0474-00-00be-1-remarks-on-the-content-channels.pptx) Remarks on the content channels (Miguel Lopez)
   * [382r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0382-00-00be-p-matrix-based-ltfs-for-eht.pptx) P-matrix based LTFs for EHT (Sameer Vermani)
   * [406r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0406-00-00be-phase-rotation-proposal.pptx) Phase Rotation Proposal (Eunsung Park)
   * [486r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0486-00-00be-decoupling-channel-training-from-nsts.pptx) Decoupling Channel Training from NSTS (Abhishek Agrawal)
5. The Chair reminds everyone to report their attendance by sending an e-mail to the Co-chair, Tianyu Wu (Apple) or the Chair himself.

**Attendance**

The following people recorded their attendance for this call:

* Ahmed Elsherif (Qualcomm)
* Al Petrick (InterDigital)
* Allert Van Zelst (Qualcomm)
* Bin Tian (Qualcomm)
* Bo Sun (ZTE)
* Carol Ansley (CommScope)
* Chenghe Ji (Huawei)
* Dandan Liang (Huawei)
* Dennis Sundman (Ericsson)
* Dongguk Lim (LG)
* Eunsung Park (LG)
* Feng Jiang (Intel)
* Hanqing Lou (InterDigital)
* Jianhan Liu (Mediatek)
* Jim Lansford (Qualcomm)
* Jinsoo Choi (LG)
* John Son (WILUS)
* Junhoon Suh (Huawei)
* Kiran Uln (Cypress)
* Leif Wilhelmsson (Ericsson)
* Lily Yunping Lyu (Huawei)
* Massinissa Lalam (Sagemcom)
* Mengshi Hu (Huawei)
* Miguel Lopez (Ericsson)
* Ming Gan (Huawei)
* Myeongjin Kim (Samsung)
* Niranjan Grandhe (NXP)
* Oded Redlich (Huawei)
* Prashant Sharma (NXP)
* Ron Porat (Broadcom)
* Rui Cao (NXP)
* Rui Yang (InterDigital)
* Sameer Vermani (Qualcomm)
* Shawn Sanghyun Kim (WILUS)
* Shimi Shilo (Huawei)
* Sigurd Schelstraete (Quantenna/On Semiconductor)
* Steve Shellhammer (Qualcomm)
* Tianyu Wu (Apple)
* Vinko Erceg (Broadcom)
* VK Jones (Qualcomm)
* Wook Bong Lee (Samsung)
* Xiaogang Chen (Intel)
* Yan Xin (Huawei)
* Yan Zhang (NXP)
* Youhan Kim (Qualcomm)
* Yujin Noh

**New Submissions**

1. **11-20-0439r0 – Efficient EHT Preamble Design –** Jianhan Liu (Mediatek)

**Summary:** Proposal for efficient EHT preamble that allows different signalling information on different 80MHz segment.

**Discussion:**

C: Need to decode all 4 channels within an 80MHz?

A: Yes. From generation to generation, the requirements is higher.

C: Need to include some MAC experts to review the contribution.

SP deferred till other options have been discussed.

1. **11-20-0474r0 – Remarks on the content channels –** Miguel Lopez (Ericsson)

**Summary:** Proposed to use Erasure code for EHT SIG.

**Discussion:**

C: Any simulation results?

A: From the analysis, there is no performance loss.

SP#1

* **Do you agree that TGbe should consider the use of low complexity erasure codes in the design of the content channels?**

Y/N/A: 9/14/22

1. **11-20-0382r0 – P-matrix based LTFs for EHT –** Sameer Vermani (Qualcomm)

**Summary:** Presented simulation results and showed that P-matrix based LTF design is robust to CFO spreads. Propose to adopt P-matrix based design for all spatial multiplexing modes in EHT.

**Discussion:**

C: May need further discussion on P-matrix for large dimension.

C: Do you assume perfect power control in your simulation?

A: Yes.

C: When you say CFO tracking, you mean for LTF not for data right?

A: Data part always have tracking. We refer to tracking for LTF in the contribution.

SP#2

* **Do you agree to adopt P-matrix based modulation of EHT-LTFs for all spatial multiplexing modes (both UL and DL) defined in EHT?**
  + All spatial streams are active during EHT-LTFs on every non-zero LTF tone
  + Applicable to multi-AP transmission modes as well

Y/N/A: 30/0/11

1. **11-20-0406r1 – Phase Rotation Proposal –** Eunsung Park (LG)

**Summary:** Proposed phase rotation for 320MHz PPDU and evaluated PAPR performance.

**Discussion:**

C: Some concern on the performance of L-SIG, may need some more discussion

C: Can you also take U-SIG into consideration?

A: Yes.

SP deferred for more discussions.

1. **11-20-0486r0 – Decoupling Channel Training from NSTS –** Abhishek Agrawal (Quantenna/ON semiconductor)

**Summary:** Propose to decouple N\_EHTLTF from NSTS and signal separately. Allow using larger number of LTF symbols can bring some gain.

**Discussion:**

C: How much gain depends on smoothing implementation. The gain can be smaller with some implementation choice.

C: Adding more LTF brings overhead, it’s a tradeoff.

C: Is it possible to make it optional to let Rx decide?

A: Tx may be able to learn it and decide number of LTF. May not need to signal from Rx.

SP#3

* **Do you support to optionally allow flexible NEHT-LTF and include NEHT-LTF in EHT packets sent to a single user?**

Y/N/A: 11/12/16

**Adjourn**

The meeting is adjourned at 12:50 PM ET

**Thursday March 26th, 2020 19:00 – 22:00 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, Quantenna/ON Semiconductor) calls the meeting to order at 19:00pm ET.
2. The Chair follows the agenda in 11-20/0425r12
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. Nobody speaks up.
4. Discussions on the agenda. Planned presentation list for today:
   1. [394r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0394-00-00be-thoughts-on-ru-aggregation-and-interleaving.pptx) Thoughts on RU Aggregation and Interleaving (Bin Tian)
   2. [405r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0405-00-00be-ldpc-tone-mapper-for-multiple-ru-aggregation.pptx) LDPC tone mapper for Multiple RU aggregation (Eunsung Park)
   3. [440r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0440-00-00be-segment-parser-and-tone-interleaver-for-11be.pptx) Segment Parser and Tone Interleaver for 11be (Jianhan Liu)
   4. [470r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0470-00-00be-small-size-mru-with-different-mcs-and-bcc.pptx) Small Size MRU with Different MCS and BCC (Junghoon Suh)
   5. [478r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0478-00-00be-segment-parsing-for-punctured-transmissions.pptx) Segment parsing for punctured transmissions (Sigurd Schelstraete)
   6. [495r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0495-00-00be-discussions-on-multi-ru-aggregation.pptx) Discussions on multi-RU aggregation (Tianyu Wu)
5. The Chair reminds everyone to report their attendance by sending an e-mail to the Co-chair, Tianyu Wu (Apple) or the Chair himself.

**Attendance**

The following people recorded their attendance for this call:

|  |  |
| --- | --- |
| An, Song-Haur | INDEPENDENT |
| Cao, Rui | NXP Semiconductors |
| Chen, Xiaogang | Intel |
| Choi, Jinsoo | LG ELECTRONICS |
| CHUN, JINYOUNG | LG ELECTRONICS |
| Dong, Xiandong | Xiaomi Inc. |
| Duan, Ruchen | SAMSUNG |
| ElSherif, Ahmed | Qualcomm Incorporated |
| Erceg, Vinko | Broadcom |
| Gan, Ming | Huawei |
| Grandhe, Niranjan | NXP |
| Guo, Qiang | Futurewei Technologies |
| Handte, Thomas | Sony Corporation |
| Hu, Mengshi | Huawei |
| Huang, Lei | Panasonic Asia Pacific Pte Ltd. |
| Ji, Chenhe | Huawei Technologies Co. Ltd |
| jiang, feng | Intel Corporation |
| JONES, JEFFRUM | Qorvo |
| Jones, Vincent Knowles IV | Qualcomm Incorporated |
| Kain, Carl | USDoT |
| Kim, Myeong-Jin | SAMSUNG |
| Kim, Sanghyun | WILUS Inc |
| Kim, Youhan | Qualcomm Incorporated |
| Lee, Wookbong | SAMSUNG |
| Li, Qinghua | Intel |
| Lim, Dong Guk | LG ELECTRONICS |
| Liang Dandan | Huawei |
| Liu, Chenchen | Huawei |
| Liu, Jianhan | MediaTek Inc. |
| Lou, Hanqing | InterDigital |
| Lou, Hui-Ling | NXP |
| Minotani, Jun | Panasonic Corporation |
| Nakano, Takayuki | Panasonic |
| noh, yujin | Newracom Inc. |
| Pare, Thomas | MediaTek Inc. |
| Park, Eunsung | LG ELECTRONICS |
| Petrick, Albert | InterDigital, Inc. |
| porat, ron | Broadcom Corporation |
| Puducheri, Srinath | Broadcom Corporation |
| Pulikkoonattu, Rethnakaran | Broadcom Corporation |
| Redlich, Oded | Huawei |
| Schelstraete, Sigurd | Quantenna Communications, Inc. |
| Sharma, Prashant | NXP Semiconductors |
| Shellhammer, Stephen | Qualcomm Incorporated |
| Shilo, Shimi | HUAWEI |
| Son, Ju-Hyung | WILUS Inc. |
| SUH, JUNG HOON | Huawei Technologies Co. Ltd |
| Sun, Bo | ZTE Corporation |
| Tian, Bin | Qualcomm Incorporated |
| Tsodik, Genadiy | Huawei Technologies Co. Ltd |
| Uln, Kiran | Cypress Semiconductor Corporation |
| Varshney, Prabodh | Nokia |
| Vermani, Sameer | Qualcomm Incorporated |
| Ward, Lisa | Rohde & Schwarz |
| Wu, Tianyu | Apple, Inc. |
| Xin, Yan | Huawei |
| Yan, Aiguo | Oppo |
| Yang, Bo | Huawei Technologies Co. Ltd |
| YANG, RUI | InterDigital, Inc. |
| Yang, Steve TS | MediaTek Inc. |
| Young, Christopher | Broadcom Corporation |
| Zhang, Hongyuan | NXP Semiconductors |
| Zhang, Yan | NXP Semiconductors |

**New Submissions**

1. **11-20-0394r1 – Thoughts on RU aggregation and Interleaving –** Bin Tian (Qualcomm)

**Summary:** Proposal on joint interleaving for RU and aggregated RU with BW<=80MHz. Per 80MHz segment parser options.

**Discussion:**

C: Do you consider 20MHz based segment parser and interleaver within 20MHz?

A: There will be performance loss. With 80MHz parser, almost no diversity gain loss.

SP deferred till other options have been discussed.

1. **11-20-0474r1 – LDPC tone mapper for Multiple RU aggregation** **–** Eunsung Park (LG)

**Summary:** Proposed LDPC tone mapper and provide some simulation results.

**Discussion:**

C: We pick DTM = 6 because the performance is slightly better.

A: In our simulation, with some settings DTM = 6 is better but with some other settings DTM = 4 is better.

C: Do you consider joint interleaver for large-size RU combination?

A: We are open.

C: Do you assume DCM in 11be?

A: We are open with DCM. But DCM has some gain and can be used in 11be.

C: We can consider DCM later.

SP deferred till other options have been discussed.

1. **11-20-0440r1 – Segment parser and Tone interleaver for 11be** **–** Jianhan Liu (Mediatek)

**Summary:** Evaluated performance of joint tone interleaver and separate tone interleaver for each 80MHz segment. Also compared the performance of different segment parser.

**Discussion:**

C: Do you consider different MCS on different freq segment?

A: Not for now but it is reflected by NBPSCS in s.

C: Why not use some ratio with no leftover bits?

A: There is ~0.3dB performance loss.

C: Consider implementation simplicity, we prefer option 2 for handling the leftover bits.

SP deferred till other options have been discussed.

1. **11-20-0470r0 – Small size MRU with different MCS and BCC** **–** Junghoon Suh (Huawei)

**Summary:** Propose to allow different MCS on small size RU combination. Introduced a number of options for BCC encoder and interleaver.

**Discussion:**

C: CCA rule does not allow different MCS within a 20Mhz.

C: It’s way to complicated for option 1 and 2.

C: Do you mean different MCS or different modulation? Your option 2 can support different MCS.

A: I tried different MCS in my simulation.

C: What about LDPC case?

A: We did not try LDPC.

SP deferred till other options have been discussed.

1. **11-20-0478r0 – Segment parsing for punctured transmissions** **–** Sigurd Schelstraete (Quantenna/On semiconductor)

**Summary:** Propose a segment parsing scheme.

**Discussion:**

C: There is no performance difference comparing to 440r1.

SP deferred till other options have been discussed.

1. **11-20-0495r1 – Discussions on Multi-RU aggregation –** Tianyu Wu (Apple)

**Summary:** Propose new BCC interleaver and LDPC tone mappers for small-size RU aggregation and large-size RU aggregation within a freq subblock. Also proposed a few freq subblock parser options.

**Discussion:**

C: In some cases, the parsing block is larger, there are 0.3dB performance loss comparing to segment parser with smaller parsing blocks.

SP deferred till other options have been discussed.

**Adjourn**

The meeting is adjourned at 22:00 PM ET

**Monday March 30th, 2020 19:00 – 22:00 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, Quantenna/ON Semiconductor) calls the meeting to order at 19:00pm ET.
2. The Chair follows the agenda in 11-20/0425r13
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. Nobody speaks up.
4. Discussions on the agenda. Planned presentation list for today:
   1. StrawPolls on segment parsing/tone mapper/interleaver for multi-RU
   2. [473r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0473-00-00be-impact-of-multiple-ru-allocation-on-papr.pptx) Impact of Multiple RU Allocation on PAPR (Genadiy Tsodik)
   3. [402r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0402-00-00be-u-sig-and-eht-sig-contents-discussion.pptx) U-sig-and-eht-sig-contents-discussion (Ross Jian Yu)
   4. [524r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0524-00-00be-signaling-of-preamble-puncturing-in-su-transmission.pptx) Signaling-of-preamble-puncturing-in-su-transmission (Dongguk Lim)
   5. [483r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0483-00-00be-preamble-puncturing-for-ppdus-transmitted-to-multiple-stas.pptx) Preamble Puncturing for PPDUs Transmitted to Multiple STAs (Oded Redlich)
   6. [545r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0545-00-00be-multi-segment-eht-sig-design-discussion.pptx) Multi-segment EHT-SIG design discussion (Ross Yu)
   7. StrawPolls on preamble, multi-RU allocation (439, 380, 285, 524, 373)
   8. [479r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0479-00-00be-240-mhz-channelization.pptx) 240 MHz channelization (Sigurd Schelstraete)
   9. [456r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0456-00-00be-tx-evm-requirement-for-4k-qam.pptx) Tx EVM Requirement for 4k QAM (Qinghua Li)
   10. [480r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0480-00-00be-4096-qam-straw-polls.pptx) 4096 QAM Straw Polls (Sigurd Schelstraete)
5. The Chair reminds everyone to report their attendance by using imat online tool <https://imat.ieee.org/802.11/attendance-log?p=3024800005&t=47200043>   
   or sending an e-mail to the Co-chair, Tianyu Wu (Apple) or the Chair himself.

**Attendance**

The following people recorded their attendance for this call:

|  |  |
| --- | --- |
| Bei, Jianwei | NXP Semiconductors |
| Cao, Rui | NXP Semiconductors |
| Chen, Xiaogang | Intel |
| Choi, Jinsoo | LG ELECTRONICS |
| de Vegt, Rolf | Qualcomm Incorporated |
| Doostnejad, Roya | Intel Corporation |
| Duan, Ruchen | SAMSUNG |
| ElSherif, Ahmed | Qualcomm Incorporated |
| Guo, Qiang | Futurewei Technologies |
| Hervieu, Lili | Cable Television Laboratories Inc. (CableLabs) |
| Hu, Mengshi | HUAWEI |
| Jia, Jia | Huawei Technologies Co., Ltd |
| jiang, feng | Intel Corporation |
| Kim, Myeong-Jin | SAMSUNG |
| Kim, Sanghyun | WILUS Inc |
| Kim, Youhan | Qualcomm Incorporated |
| Lansford, James | Qualcomm Incorporated |
| Lee, Wookbong | SAMSUNG |
| Li, Qinghua | Intel Corporation |
| Liang, dandan | Huawei Technologies Co., Ltd |
| Lim, Dong Guk | LG ELECTRONICS |
| Lin, Wei | Huawei Technologies Co. Ltd |
| LIU, CHENCHEN | Huawei Technologies Co., Ltd |
| Liu, Jianhan | MediaTek Inc. |
| Lou, Hanqing | InterDigital, Inc. |
| Lv, Lily | Huawei Technologies Co. Ltd |
| Minotani, Jun | Panasonic Corporation |
| Montreuil, Leo | Broadcom Corporation |
| Nakano, Takayuki | Panasonic Corporation |
| Pare, Thomas | MediaTek Inc. |
| Park, Eunsung | LG ELECTRONICS |
| Petrick, Albert | InterDigital, Inc. |
| porat, ron | Broadcom Corporation |
| Puducheri, Srinath | Broadcom Corporation |
| Redlich, Oded | Huawei |
| Schelstraete, Sigurd | Quantenna Communications, Inc. |
| Sharma, Prashant | NXP Semiconductors |
| Shellhammer, Stephen | Qualcomm Incorporated |
| Shilo, Shimi | HUAWEI |
| Son, Ju-Hyung | WILUS Inc. |
| SUH, JUNG HOON | Huawei Technologies Co. Ltd |
| Tian, Bin | Qualcomm Incorporated |
| Tsodik, Genadiy | Huawei Technologies Co. Ltd |
| Uln, Kiran | Cypress Semiconductor Corporation |
| Varshney, Prabodh | Nokia |
| Vermani, Sameer | Qualcomm Incorporated |
| Ward, Lisa | Rohde & Schwarz |
| Wu, Tianyu | Apple, Inc. |
| Xin, Yan | Huawei Technologies Co., Ltd |
| Yan, Aiguo | Oppo |

**Straw Polls**

1. **SP1: SP1 from 394r1**

**Discussion for SP1:**

C: Why not do interleaver within 20MHz and RU parser for >20MHz?

A: Keep same architecture as in 11ac/ax.

SP#1

* **Do you support joint interleaving for RU and aggregated RU size <=80 MHz?**

Y/N/A: 38/9/11

1. **SP2: based on SP1 from 440r1**

**Discussion for SP2:**

C: Some discussions on the SP text.

SP#2

* **Do you agree with the following LDPC tone mapper scheme for multi-RU aggregation in 11be?**
  + **For aggregated RUs and PPDU BW larger than 80MHz, separate LDPC tone mapper is applied in each 80MHz segment.**

Y/N/A: 44/ 8 / 9

1. **SP3: based on SP4 from 394r1**

SP#3

* **Do you agree the segment parser bit distribution sequence starts from the lowest frequency location to the highest frequency, just like in 11ac/ax?**

Y/N/A: 53/0/8

1. **SP4: based on SP3 from 394r1**

SP#4

* **Do you support the following LDPC tone mapper parameters:** 
  + **for RU52+26: D\_TM = 4**
  + **for RU106+26: D\_TM = 6**
  + **Existing RUs: identical to 11ax**

Y/N/A: 54/0/7

1. **SP5: based on SP3 from 394r1**

SP#5

* **Do you support the following LDPC tone mapper parameters:** 
  + **for RU484+242: D\_TM = 18**

Y/N/A: 53/9/10

1. **SP6: Joint SP based on SP2 from 440r1 and SP4 from 495r1**

SP#6

* **Do you agree that 11be uses 80MHz segment parser with proportional round robin scheme?**

Y/N/A: 48/0/10

**New Submissions**

1. **11-20-0473r0 – Impact of Multiple RU allocation on PAPR** **–** Genadiy Tsodik (Huawei)

**Summary:** The contribution shows the PAPR impact caused by MRU allocation and proposed a number of solutions such as linear phase offset.

**Discussion:**

C: Meaning of the linear phase offset? Change phase rotation how many tones?

A: Each tone has different phase rotation and linear phase rotation with respect to the tones.

C: Are you simulate UL TB PPDU?

A: For small RU you are right. For large RU, it can be DL as well.

C: For DL, the problem is not the multi-RU, it’s puncturing right?

A: For DL, yes.

C: RU484+RU242 can be contiguous or have different gap between them. What is assumed in your simulation?

A: I simulated all of them.

C: With different BWs, there are different number of cases. How many cases do you simulated?

A: We simulated all the cases currently defined.

C: Are you intended to optimize each of these cases by define the slope of phase rotation?

A: Yes.

C: Will there have phase jump between 40MHz?

A: Yes, there is jump.

C: Then there will have problem with smoothing.

C: There are many methods to do PAPR reduction. This method can be implementation decided and no need to specify in the standard.

A: This cannot be transparent because your smoothing may change depending on the phase rotation.

C: Which PA model you used in the simulation? May need it to regenerate and compare the performance.

A: I am not sure. Will check.

SP deferred for more discussions.

1. **11-20-0402r0 – U-SIG and SIG contents**  **–** Ross Jian Yu (Huawei)

**Summary:** The contribution propose to have 1 symbol EHT SIG for EHT PPDU to single STA and proposed contents for U-SIG and EHT SIG.

**Discussion:**

C: If MCS goes up to MCS1, there will be no overhead loss.

C: For cell edge user, HE format PPDU can be used if really care about the 4us loss.

A: We already have 4us loss comparing to 11ax, do not want to have 8us loss.

SP deferred for more discussions.

**Adjourn**

The meeting is adjourned at 22:00 PM ET