IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Meeting Minutes for 11be PHY ad hoc sessions January 2020,  Irvine, CA | | | | | | Date: 2020-01-13 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Tianyu Wu | Apple |  |  | Tianyu@apple.com | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

This document contains the meeting minutes of the IEEE 802.11be PHY ad-hoc sessions held during the January 2020 IEEE meeting.

**REVISION NOTES:**

**R0**: Minutes from Monday PM2 PHY ad hoc meeting.

**R1**: Add minutes from Tuesday PM1 and Tuesday PM3 PHY ad hoc meetings.

**R2**: Add minutes from Wednesday AM1 PHY ad hoc meeting.

**R3**: Add minutes from Wednesday PM2 PHY ad hoc meeting.

**R4**: Add minutes from Thursday AM1 and AM2 PHY ad hoc meetings.

**Session 1: Monday 13 January PM2 (16:00 – 18:00)**

**Introduction**

1. The Chair calls the meeting to order at 16:00. The agenda is found in 11-20-0139r1.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the proposed agenda items.

## Straw Polls

First order of business is to run straw polls from selected submissions that were presented during conference calls, but for which the SPs were deferred to the F2F meeting.

C: Suggest having fruitful discussions on topics. Better finish the presentations before running SP on the topic.

C: Better to go throughput SPs but when any SP have related contributions, people can request to defer the SP after the contributions.

**Deferred Straw Polls**

1. **11-19-1868r2 - Signaling Support for Multi-RU Assignment** – Lei Huang (Panasonic)  
    **Straw poll 1:**  
   Do you agree that a user specific field of EHT-SIG in an EHT PPDU transmitted to multiple users comprises ~~one or~~ more than one user fields?

Note: each user field contains user-specific allocation information.

**Discussion:**  
C: It’s not very clear to me what is multiple users compromises more user fields? And we did not agree on basics such as how many RUs can be combined. It’s too early to decide the signaling.   
A: This SP is not related to RU combination.

C: One user field is not meaningful.

A: Change to more than one user field.

C: What you want to achieve is already in the SFD.

C: Also agree that there is already same thing in the SFD.   
A: Skip this SP.

**Result:**  
SP deferred.   
  
 **Straw poll 2:**  
Do you agree that the formats of 11be user specific fields should be optimized for improving STA’s power efficiency?

**Discussion:**  
C: Can you clarify what is this SP asking for?  
A: Explained Opt 2 in the contribution.

C: Do you asking to include it in SFD or just encouraging people to consider power saving?

A: Encouraging design EHT SIG considering power efficiency.

C: Optimized is too strong for me. There are many factors need to considered.   
  
**Result:**  
Y 21  
N 0  
A 38

1. **11-19-1869r0 - Preamble Puncturing and RU Aggregation** – Bin Tian (Qualcomm)  
     
   **Straw poll 1:**  
   **Do you support in 11be**

* CCA minimum BW resolution is 20MHz
* Preamble puncturing resolution is 20MHz

**Discussion:**

**Result:**  
Y 59  
N 0  
A 3

**Straw poll 2:**  
Do you support one PSDU per STA for single link in 11be?

**Discussion:**

**Result:**  
Y 48  
N 0  
A 5

**Straw poll 3:**  
For one PSDU, do you support in 11be to use one LDPC encoder?

* + ~~Note: Multiple modulations for one PSDU is TBD. This SP only applies to the single modulation per PSDU case.~~

**Discussion:**

C: Different channel can use different MCS?

A: One PSDU one modulation is simpler. But I would like to leave it for further discussion.

C: You can remove the note.

A: Removed.

C: What about BCC? Do you want to leave BCC TBD?

A: BCC is different since in 11n 11ac already have multiple BCC encoders for wider BW. We need to decide what is the max BW apply for BCC. BCC situation is more complicated.

**Result:**  
Y 49  
N 0  
A 4

1. **11-19-1877r1 – 16 Spatial Stream Support** – Woodbong Lee (Samsung)  
     
   **Straw poll 2:**  
   **Do you support maximum 16 spatial streams for MU-MIMO in 11be?**  
     
   **Disucssion**  
     
   **Result:**  
   Y 46  
   N 0  
   A 2  
     
     
   **Straw poll 1:**  
   **Do you support that 11be defines a maximum of 16 spatial streams for SU-MIMO?**

**Disucssion**  
C: Support 16SS could be difficult. Need to add capability.   
A: Yes, capabilities can be added as in 11ac, 11ax  
C: Suggest to make it optional

A: Change to 11be define a mode.   
  
**Result:**  
Y 37  
N 0  
A 7

1. **11-19-1890r1 -** **Phase Rotation Follow-up**– Eunsung Park (LG)  
     
   **Straw poll 2:**  
   **Which option do you prefer for the phase rotation in 320/160+160 MHz**

**Option 1: Unified phase rotation regardless of whether the preamble puncturing is applied or not**

**Option 2: Different phase rotation according to whether the preamble puncturing is applied or not**

**Option 1/Option 2/A: //**

**Disucssion**

C: Can you add the sentence saying this SP not affect SFD?  
A: Ok.  
  
  
**Result:**  
Opt 1: 11  
Opt 2: 13  
A : 22

**Straw poll 1:**  
**Do you agree that preamble puncturing can be considered in order to design phase rotation for 320/160+160 MHz?**

**Disucssion**

Author: This will not affect SFD as well.

**Result:**  
Y: 9  
N: 0  
A: 31

**Other SPs deferred.**

1. **11-19-1907r1 – Multiple RU Combinations for EHT** – Jianhan Liu (Mediatek)

**Straw poll 1:**  
**Do you agree that small-size RUs can only combine with small-size RUs and large-size RUs can only combine with large-size RUs?**

* + **RUs with equal to or more than 242 tones are called as large-size RUs**
  + **RUs with less than 242 tones as small-size RUs**

**Disucssion:**

C: Not against the SP but we have similar contribution. Can you defer it?

A: Ok.

C: How to handle the 242RU with a few tones across the 20MHz boundary? It’s no longer 242+484.   
A: There are many methods to handle it.

**Result:**  
Deferred for later this week.

**Straw poll 2:**  
**Do you agree that combination of small-size RUs shall not cross 20MHz channel boundary?**

**Disucssion:**

C: We have similar contributions. Ask for a defer. May have different opinion.   
A: I still prefer to run.

C: Can we ask note that not for SFD?

A: No, this is for SFD update.

**Result:**  
Y: 34  
N: 1  
A: 22

**Straw poll 3:**  
**Do you agree that only allowed small-RU combinations are RU106+RU26 and RU52+RU26?**

**Disucssion:**

C: We have similar contributions. Ask for a defer. We have different opinion.  
A: Prefer to run it now.

C: Ask for defer. We againt ”only” part.

A: Will you agree if we remove ”only”?

C: We need to keep ”Only”.

A: Ok, I will defer this one.

**Result:**  
Deferred.

**Straw poll 4:**  
**Do you agree that for 20 and 40 MHz PPDU, within 20MHz boundary, any contiguous RU26 and RU106 can be combined?**

**Disucssion:**

**Result:**  
Deferred.

**SP 5 – SP 9 are deferred.**

1. **11-19-1908r2 – Multi-RU Support** – Ron Porat (Broadcom)

**Straw poll 1:**  
**Do you support the conditional mandatory (conditional on supporting puncturing) large RU combinations for 80MHz non-OFDMA as described below:**

* **484+242 supports contiguous 60MHz and non-contiguous 60MHz**
  + **Puncturing one 20MHz anywhere in the 80MHz channel**
* **For 242+242 we only support the case where both 242 RUs are the outer ones in the 80MHz (a [1001] configuration)**
* **Note: several tones at the edge may be punctured**

|  |  |
| --- | --- |
| **RU size** | **Agg. BW** |
| 242+242 | 40 MHz |
| 484+242 | 60 MHz |

**Disucssion:**

C: Slide 5 have so many information. Suggest to break into several steps. First on BW then on combinations.

A: I can copy the points in slide 5 to the SP. It’s clear to me.

C: More modes such as1010, 0110 etc should be allowed  
A: We donot like too many modes. For 0110 we can do 1100 as 40MHz.

C: This is for SU case right? What does the conditional mandatory means? At least transmission is opitional.

A: Add conditional on supporting puncturing.

C: What is the meaning of ”several tones at the dege may be punctured”.

A: This is for the case where a few tones across the 20MHz channel boundary.

**Result:**  
Y: 18  
N: 16  
A: 19

**Straw poll 2:**  
**Do you support the large RU combinations for 80MHz OFDMA as described below?**

|  |  |
| --- | --- |
| **RU size** | **Agg. BW** |
| 484+242 | 60 MHz |

**Disucssion:**

C: Can you copy the text to the SP?

A: Ok.

C: Conditional mandatory meaning? There is not necessary a puncturing mode for OFDMA case.

C: Suggest to remove the conditional mandatory.

A: If puncture not supported, may not support this mode in OFDMA as well.

C: Remove the condition for now.

**Result:**  
Y: 29  
N: 0  
A: 14

**Straw poll 3:**  
**Do you support the large RU combinations for 160MHz non-OFDMA as described as described below?**

* + **CM – conditional mandatory on supporting puncturing**
  + **O- optional**

|  |  |  |  |
| --- | --- | --- | --- |
| **80MHz**  **RU size** | **80MHz**  **RU size** | **Agg. BW** | **Notes** |
| 484 | 996 | 120 MHz | CM |
| 484+242 | 484+242 | 120 MHz | O |
| 484+242 | 996 | 140 MHz | CM |

**Disucssion:**

C: Same comment on the conditional mandatory.

C: I did not see much value on the 60MHz puncturing case.

A: It’s ok to remove this mode from SP.

C: Also questioning on 242+242+996 case.

A: Remove these 2 modes from the SP.

C: Can you defer this SP?

A: Ok.

C: For each size, there are still multiple modes of combination. Suggest to further limit the modes. We donot need to support all combinations for each size.

A: Ok, we can have further discusssion.

**Result:**  
SP deferred.

**Straw poll 4:**  
**Do you support the large RU combinations for 160MHz OFDMA as described in slide 8?**

* **() means within 80MHz**

|  |  |
| --- | --- |
| **RU size** | **Agg. BW** |
| (484+242) | 60 MHz |
| 484+(484+242) | 100 MHz |
| 484+996 | 120 MHz |

**Disucssion:**

C: We have some different views and request a defer of the SP.

A: Do you want more combinations or less?

C: Less combinations.

**Result:**  
Deferred.

**Recess.**

**Session 2: Tuesday 14 January PM1 (13:30 – 15:30)**

**Introduction**

1. The Chair calls the meeting to order at 13:30. The agenda is found in 11-20-0139r2.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the proposed agenda items.

## Straw Polls

**Continue on deferred Straw Polls**

1. **11-19-1914r2 - Multiple RU discussion** – Ross Jian Yu (Huawei)  
    **Straw poll 1:**

Which option do you prefer?

Opt1

Opt2

Opt3

Opt4

Need more discussion

|  |  |
| --- | --- |
|  | **Method** |
| Opt1 | act as transmit the data to two different users, each RU is encoded, interleaved separately |
| Opt2 | The bits are encoded together, and parse to different RUs, separate interleaver/tone mapper |
| Opt3 | Opt1/Opt2+interleaver across RUs |
| Opt4 | Act as one big continuous RU |

**Discussion:**  
C: We have similar contribution.

C: This is not clear to me, may need further discussion on more details.

**Result:**  
SP deferred.

1. **11-19-1980r1 - EHT P matrices Discussion** – Dandan Liang (Huawei)  
     
   **Straw poll 1:**  
   **Do you support to ~~have~~ include 1x EHT-LTF and 2x EHT-LTF in 802.11be?**

**Discussion:**  
C: Do we support 4x LTF?

A: We are open to it.

C: Suggest change to ”include 1x, 2x LTF”

A: Ok.

**Result:**  
Y 47  
N 0  
A 2

**Straw poll 2:**

**Do you support to have new P matrices of dimensions for the number of space-time streams larger than 8 in EHT?**

* + **The definition of is TBD**

**Discussion:**

C: I need more time to think about 10x10 and 14x14. Can you remove these two modes?

C: We are still investigating tone interleave based and large P matrix based. Can you defer the SP?

A: Ok.

**Result:**  
SP deferred.

1. **11-19-1981r1 – Phase Rotations Design for EHT** – Dandan Liang (Huawei)  
     
   SP deferred.

## Backlogged submissions

1. **11-19-1910r1 -** **P matrices to support more than 8 TX chains** – Miguel Lopez (Ericsson)

**Summary:** Authors proposed methods to support P matrix with zeros for >8 SS.

**Disucssions:**

C: What about PAPR effect?  
A: There is some PAPR change, not very big.   
C: Suggest to rotate replacing some of 1, -1s by j -j etc.

C: This is a modified way of tone interleaved LTF right?

A: Yes.   
 C: How to justify the performance? What is the benefit to have zeros in P matrix.

A: The benefit is to avoid complex number and reduce complexity.

C: If you consider UL transmission, the zeros will be quite periods.

A: This works better for DL.

**No SP.**

1. **11-19-1925r1 – Consideration of EHT-LTF** – Jinsoo Choi (LG)

**Summary:** Authors presented EHT LTF design for 240/320MHz and punctured cases. Propose to consider overhead and PAPR performance in the design. To reduce the PAPR for punctured cases, propose to either restrict the puncturing modes or design new LTF sequences to optimize the PAPR.

**Straw poll 1:**  
**Do you agree to add the following text into SFD?**

* + **EHT-LTF should be designed to support 16 spatial streams.**

**2x and/or 1x HE-LTF concept as in 11ax may be used for EHT-LTF overhead reduction**

**Result:**  
Y 58  
N 0  
A 2

**Straw poll 2:**  
**Which option do you prefer for 11be 240/320MHz EHT-LTF design by minimizing PAPR?**

* + **Opt1: Restrict preamble puncturing cases by practical puncturing patterns (The detail on puncturing patterns is TBD)**
  + **Opt2: Consider defining whole new sequences**

**Result:**  
Opt 1: 6  
Opt 2: 4  
Abs: 38

## Submissions

C: Suggest to switch the order of preamble and multi-RU topic.

A: The order is follow the approved agenda.

1. **11-20-0020r0 – Consideration for EHT-SIG transmission** – Dongguk Lim (LG)

**Summary:** The authors provided 3 options for EHT-SIG content channels. [1 2 1 2 1 2 1 2], [1 2 1 2 3 4 3 4] and [1 2 3 4 1 2 3 4]. The contribution compared the options in terms of overhead and flexibility and proposed option 3.

**Disucssions:**

C: Different options have different signaling of preamble puncturing. It will be better if you can provide more details as a whole picture.   
C: Slide 10, whin each 80, the 1,2,3,4 are signaling different contents? Not as the 1,2,1,2 in 80MHz of 11ax?

A: Yes, it’s more efficient.

C: Slide 5, you are thinkg signaling 9 users on each 20MHz?

A: Yes, we consider the worst case for overhead calculation.

C: May need to discuss whether this is a reasonable use case. We expect similar number of users but larger RU for each user.

C: For some of your options, you require receiver to decode >80MHz, it will consume more processing power. We strongly prefer to have options with no more processing power than 11ax.

**Straw poll 1:**

**~~Do you agree that 11be supports a capability of EHT-SIG reception by more than 80MHz?~~**

* + - **~~The configuration of EHT-SIG content channel is TBD.~~**

**~~Do you agree that 11be EHT-SIG information is self contained in more than 80MHz?~~**

**Do you agree that 11be EHT-SIG information is not self contained within 80MHz?**

**Disucssion:**

C: What is the meaning of this SP. Do you mean receiver need to receive >80MHz BW for preamble?

A: Means RX can receive 160MHz for preamble.

C: Always require SIG reception of wide BW, there will be power consumption issue.

C: Strongly suggest 80MHz self contained SIG.

A: 11ax already have the capability of Rx of 160 SIG.

C: SIG is different from data portion. This is not a capability. It’s mandate all receiver to decode a wide BW SIG.

C: Suggest to change the SP to do you agree that 11be EHT SIG is self contained in 80MHz channel?

C: Suggest to defer after we have more detailed design for preamble puncturing.

**Result:**  
SP defered.

**Straw poll 2:**

* **Do you agree that in large BW transmission (160MHz), EHT-SIG content channels are configured as option 3 described in slide 10?**

1

2

3

4

1

2

3

4

1

2

3

4

1

2

3

4

320MHz

80MHz

* + **Duplicating EHT-SIG information per 80MHz, with different EHT-SIG information in each 20MHz within 80MHz.**

**Disucssion:**

C: Suggest to defer the SP for further discussions.

A: Ok

**Result:**  
SP defered.

**Straw poll 4:**

**Do you agree that the preamble puncturing can be indicated by using the BW field and puncturing pattern field?**

* + **The details on configuration for the preamble puncturing are TBD.**

**Disucssion:**

C: In 11ax we only use BW. Can you make the design more clear to me?

C: I donot know what is the puncturing pattern field. We did not have ”the” puncturing pattern field designed yet. This seems premature for now.

**Result:**  
SP defered.

**Recess.**

**Session 3: Tuesday 14 January PM3 (19:30 – 21:30)**

**Introduction**

1. The Chair calls the meeting to order at 19:30. The agenda is found in 11-20-0139r2.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the proposed agenda items.

## Submissions

1. **11-20-0029r1 – Preamble Structure and SIG Contents** – Ross Jian Yu (Huawei)

**Summary:** The author proposed EHT SIG structure and SIG contents for MU and SU PPDUs. Updated to r2 with updated SP text.

**Straw poll 1:**  
**Do you agree to have RU Allocation subfield in the Common field of the EHT-SIG field of an EHT PPDU sent to multiple users?**

* + **Compressed modes are TBD**
  + **Contents of RU allocation subfield are TBD**

**Disucssion:**

**Result:**  
Y 33  
N 0  
A 4

**Straw poll 2:**  
**Do you agree to have at least one compressed mode in which RU Allocation subfield doesn’t exist in the Common field of the EHT-SIG field of an EHT PPDU sent to multiple users?**

* + **Signaling method is TBD**

**Disucssion:**

C: This is pre-mature, prefer to defer the SP. How to define this compressed mode?

C: Suggest to change to at least one compressed mode.

A: Ok.

C: Still not clear to me. Suggest to defer.

C: How many modes is not clear to me.

A: I want to still have a try.

**Result:**  
Y 18  
N 6  
A 14

**Straw poll 3:**  
**Do you agree to have one compressed mode in which RU Allocation and center 26-tone RU subfields don’t exist in the ~~Common field of the~~ EHT-SIG field of an EHT PPDU sent to multiple users?**

* + **Signaling method is TBD**

**Disucssion:**

C: Is this the 1 2 1 2 structure?

A: Yes, but can be more content channels.

C: Why limit to common field?

A: I can remove common field.

C: This is premature to me. Need more time to understand how the EHT SIG is encoded.

C: Please clarify where is the content channel is defined.

A: Ok. Change the SP.

C: Ask for defer.

**Result:**  
SP Deferred.

SP4 also deferred.

**Straw poll 5:**  
**Do you agree to have the following subfields in U-SIG and/or EHT-SIG of an EHT PPDU sent to single user?**

* + **MCS**
  + **Bandwidth**
  + **NSTS**
  + **GI+EHT-LTF Size**
  + **Coding**
  + **LDPC Extra Symbol Segment**
  + **Pre-FEC Padding Factor**
  + **PE Disambiguity**

**Disucssion:**

C: Before we decide how many PPDU formats, it’s too early to SP on the fields.

A: Please let me know which field you have concern.

C: For example BW, how to signal preamble puncturing together or seperate. Also padding. Extra symbol segments etc.

C: I have similar opnion. Typically we define contents after the preamble structure is more clear and what functionality to support.

**Result:**  
SP Deferred.

**Straw poll 7:**  
**Do you agree to have the following subfields in U-SIG of an EHT PPDU sent to multiple user?**

* + **~~Bandwidth~~**
  + **EHT-SIG MCS**
  + **~~Number of EHT-SIG Symbols or MU-MIMO users~~**
  + **Number of EHT-LTF Symbols**

**Disucssion:**

**Result:**  
Y 34  
N 0  
A 7

SP6 and SP8 deferred.

1. **11-20-0049r1 – PPDU Types and U-SIG Content** – Sameer Vermani (Qualcomm)

**Summary:** The author proposed a few version independent fields in EHT SIG, proposed to have no EHT SIG field for TB PPDU and merge SU and MU PPDU in 11be.

**Disucssion:**

C: Why need to merge SU PPDU and MU PPDU format? There is no benefits

A: Benefit is less modes.

C: EHT SU PPDU no matter merge with MU PPDU or not, always have longer preamble than 11ax. In majority of cases, HE SU PPDU will have better performance.

A: Yes. You can always fall back to legacy modes.

C: SU/MU type is EHT SIG. Can you put in U-SIG? It will be better to signal puncturing in U-SIG.

**Straw poll 1:**  
**Do you agree U-SIG will contain bandwidth information, carried as a version independent field?**

* + **This information may also convey some puncturing information**
  + **Number of bits is TBD**

**Result:**  
Y 39  
N 0  
A 8

**Straw poll 2:**  
**Do you agree to add “PPDU type” as a version dependent field in U-SIG?**

* + **Number of bits is TBD**

**Disucssion:**

C: I have similar contribution. Ask for defer SP 2 and 3.

A: Ok.

**Result:**  
SP Deferred.

Continue running this SP after presentation of 0087r0.

Y 46  
N 0  
A 0

**Straw poll 3:**  
**Do you agree that in EHT, SU and MU PPDU formats will be merged into a single PPDU type?**

C: Request to defer this SP again after LG’s presentation on the same topic.

**Result:**  
SP Deferred.

1. **11-20-0075r0 – Performance Comparison of LTF Designs in JT** – Ron Porat (Broadcom)

**Summary:** The author provided two LTF design for NDP, namely 2x-all and 4x-split. Simulation results showl the two designs have similar performance. And to ensure best performance for JT, residual AP-AP CFO needs to be <=50Hz for the NDP.

**Disucssion:**

C: Is your conclusion keep current 2x LTF is good enough since the performance is same?

A: We are not yet at the conclusion. Still checking some more modes comparing performance. If proved to be same performance we’d like to keep the current mode.

C: What is the residual of residual CFO after tracking? What is the error after tracking?

A: I didnot check it in our simulation. Tracking is avoiding phase error increase linearly but what is the remaining error we donot know.

C: On slide 2, what is the P matrix size used in simulation?

A: 6x 6 for 2AP case and 12x12 for 4 AP case. For NDP, use 16.

1. **11-20-0087r0 – Discussions on U-SIG Content and EHT-SIG Format** – Rui Cao (NXP)

**Summary:** The author proposed a few version dependent bits for U-SIG and also proposed to have unified SIG structure for SU and MU PPDU.

**Disucssion:**

C: EHT-SIG MCS field 4 bit, EHT SIG number of symbol 5 bits seems too large. Can you change to a smaller number?

A: We can have further discussion for the numbers. This is just example.

C: There may have 1 extra symbol for SU PPDU if we merge SU and MU PPDU formats. STA-ID have 11 bits which may lead to 1 more symbol which is redundant information.

A: MAC people are discussing STA-ID may help to support multi-link feature.

C: Even if you have more than 20 bits extra overhead, if you can go 1 MCS level higher, there will be no extra symbol. Only for worst case with MCS 0 for EHT SIG, you may have 1 more symbol.

C: MCS 0 case could be very common.

A: Similar to SIG B in 11ax, MCS 0 is not a common case.

C: Why not consider ER SU in your contribution?

A: We have no decision on ER SU and not covered in this contribution.

C: But if you only use 1 bit for PPDU format, you exclude ER SU.

A: ER SU may need early detection.

C: Why change number of bits indicating SIG B MCS in 11ax? Any reason to increase it?

**Straw poll 1:**  
**Do you agree that U-SIG version-dependent bits include PPDU format bits for EHT?**

* **Number of bits TBD**

**Result:**  
See SP2 in 0049r1.

**Straw poll 2:**  
**Do you agree that EHT defines single PPDU format for EHT SU and EHT MU?**

**Result:**  
SP Deferred.

**Recess.**

**Session 4: Wednsday 15 January AM1 (08:00 – 10:00)**

**Introduction**

1. The Chair calls the meeting to order at 08:00. The agenda is found in 11-20-0139r2.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the proposed agenda items. Agenda approved by the group.

## Submissions

1. **11-20-0110r0 – 11be preamble and forward compatibility** – Sigurd Schelstraete (Quantenna/On)

**Summary:** The authors propose to design 11be preamble to achieve forward compatibility from 11ax.

**Disucssions:**

C: Detection mechanism including detection of trigger frame? What if trigger frame is send in high MCS and you can not decode it?

A: There will still be a frame SIFS before the frame. This can also be a clue.

C: Today detecting wifi packet is self contained. It’s a big change to rely on detection of preceding PPDU

A: It’s just making 11BE preamble looks like 11ax TB PPDU format. And 11be need new state machine anyway.

C: Are you still using the reserved bit for signalling?

A: No, reserve bit is still set to 1.

C: It seems dangerous if False/Miss detection of Trigger frame.

A: If you donot send Trigger frame, 11BE device can always assume it’s 11BE format.

C: State machine based on trigger frame is dangerous. Also on slide 10, you will redefine all green bits? How 11ax differente 11BE from 11ax TB PPDU?

A: 11ax will treat 11BE PPDU as 11ax TB PPDU and they donot need to care the bits in green. Since the spatial reuse bits are not useful without receiving Trigger frame.

C: What if there is 11ax TB PPDU but trigger frame is from OBSS. 11BE device miss the OBSS trigger frame. 11be will suffer power save (11be may keep decoding and cannot early terminate).

A: Depend on how you define the other part of 11be preamble to further confirm this is 11be PPDU.

**Straw poll 1:**  
**Do you agree that 11be preamble should be designed such that 11ax is forward compatible with the 11be preamble?**

**NOTE: “forward compatible” means having access to at least TXOP and BSS COLOR from the 11be preamble**

**Result:**  
SP Deferred.

1. **11-20-0117r0 – EHT-LTFs Design** – Dandan Liang (Huawei)

**Summary:** The author proposed EHT LTF sequence design methods for 320 and 240MHz PPDU.

**Disucssion:**

C: Your option 2 is similar to what I proposed yesterday we like this option. You donot explore preamble puncturing case in your contribution, but there could be huge PAPR difference for preamble puncturing.

A: We are open mind for preamble punctured case. Since preamble puncturing pattern is not decided, we can further study after the modes are decided.

C: Regarding 240MHz case, it could be punctured from 320MHz or stand alone 240MHz. . You may need new sequence for 240MHz.

A: We are not limited to the cases we proposed.

**Straw poll 1:**  
**Do you agree to add the following text into SFD?**

**~~-EHT-LTFs reuse HE-LTFs in 20/40/80/160/80+80MHz PPDU~~**

**-EHT-LTF sequences are the same as HE-LTFs in 20/40/80/160/80+80MHz PPDU**

**Disucssion:**

C: Add ”sequence” to the SP.

A: ok.

C: Instead of reuse, can you change to ”the same as”.

A: ok.

C: If tone interleave method is adopted for LTF, you just take half of the sequence, the PAPR is different. It may increase by 2dB. If large P matrix method is applied, there is no problem.

C: For TB PPDU, LTF sequence can be masked in frequence domain. Do you plan to follow same design for DL and UL in EHT?

C: Among all PAPRs, LTF PAPR is most important since it directly affect the channel estimation performance. Can you defer it for further check?

A: Ok.

**Result:**  
SP Deferred.

SP 2 and SP3 in r0 already passed yesterday and will be skipped here.

Change SP2 to 4x case.

**Straw poll 2:**  
**Do you agree to include 4x EHT-LTF for 320MHz/160+160MHz/240MHz/160+80MHz?**

**Disucssion:**

**Result:**  
Y 30  
N 0  
A 18

1. **11-19-2161r1 – Multiple RU Support for 11be** – Myeongjin Kim (Samsung)

**Summary:** The authors propose a number of options to support multiple RU allocation.

**Disucssions:**

C: In option 1, the interleaver/tone mapper need to be redefined, do you also consider redefine pilot tones?

A: No.

C: In summary slide, you claim option 1 has better performance than other options. Do you have simulation results?

A: We do not have simulation but theoretically, option 1 has better diversity gain.

C: For Option 4, it seems more like signaling method and different from other 3 options.

C: For option 1, I hesitate to call it new RU type. I don’t know if we should signal it as new RU or combined RU. I suggest to

avoid calling new RU type for now.

A: Will defer the SPs.

**Straw poll 1:**  
**Do you support that small-size multiple RUs can be combined and assigned to a single STA as a new RU type?**

* + **Small-size RUs: RU26, RU52, RU106**

**Result:**  
SPs Deferred.

1. **11-20-0022r0 – Consideration on 240/160+80 MHz and Preamble Puncturing** – Eunsung Park (LG)

**Summary:** The author discussed options to determine 240/160+80MHz channels, namely fixed channel, flexibile channel with MAC indication and flexible channel with PHY indication. Also proposed some fields to indicate the bandwidth and preamble puncturing patterns in SU and MU PPDUs.

**Disucssions:**

C: For 80+80, current scheme is MAC indication right? I prefer MAC over PHY indication. For puncturing pattern, I prefer a small number of patterns.

C: For 240/160+80MHz, I also prefer flexible with MAC indication. For puncturing pattern indication, need more information on preamble definition.

**Straw poll 1:**  
**Which option do you prefer for the 240/160+80 MHz channel?**

* + **Option 1: Fixed case with 240MHz channelization**
  + **Option 2: Flexible case with MAC indication (e.g., Beacon frame)**
  + **Option 3: Flexible case with PHY indication (e.g., U-SIG, EHT-SIG)**

**Disucssion:**

C: I don’t understand how to set contiguou/non-contiguous.

A: It’s option 2.

C: Please add not for SFD.

A: Ok.

C: Please clarify this for BSS operation BW not PPDU BW.

A: I intended for PPDU BW.

C: PPDU BW has to be PHY indication.

A: I will defer this SP.

**Result:**

SP deferred.

Opt 1:   
Opt 2:

Opt 3:   
Abs:

Other SPs also deferred.

**Recess.**

**Session 5: Wednsday 15 January PM2 (16:00 – 18:00)**

**Introduction**

1. The Chair calls the meeting to order at 16:00. The agenda is found in 11-20-0139r3.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the updated agenda items. Agenda approved by the group unanimously.

## Submissions

1. **11-20-0023r0 – Multiple RU Aggregation** – Eunsung Park (LG)

**Summary:** The author proposed a number of multiple RU combinations for SU and MU OFDMA cases.

**Disucssions:**

C: On slide 6, seems the unavailable edge RUs should be on 2nd 20MHz channel, not the first.

A: There are 2 tones across the 20MHz boundary.

C: But the 2 tones are from edge RUs of the 2nd 20MHz.

C: I hesitate to add this 106+26+52+26 RU. There are other methods to handle these 1-2 tones across the 20MHz boundary. It’s not worth to introduce this special mode.

SP1 deferred by the author.

SP2, SP3 and SP7 withdrawed by the author.

**Straw poll 4:**

**Do you agree to add the following text to the TGbe SFD?**

* + For the OFDMA transmission in 160/80+80 MHz, large size RU aggregation is allowed only within primary 80 or secondary 80, respectively

**Disucssion:**

C: At least we want to support 80+40 case. This is artificial restriction.

C: If you have 2 users on 160. One user donot need much data, you can put it on 484 and the other user 996+484.

A: You can assign 996 and 996 for 2 users.

C: You already build a mode, it’s better you allow this mode.

A: I can withdraw this SP.

**Result:**

SP withdrawed.

**Straw poll 5:**

**Do you agree to add the following text to the TGbe SFD?**

* + For contiguous 240MHz, large size RU aggregation is allowed only within 160MHz which is composed of two adjacent 80MHz channels
  + For non-contiguous 160+80MHz, large size RU aggregation is allowed only within contiguous 160MHz or the other 80MHz, respectively

**Disucssion:**

C: I have similar topic contribution. Can you hold the SP?

A: Ok.

**Result:**

SP deferred.

**Straw poll 6:**

**Do you agree to add the following text to the TGbe SFD?**

* + **For the OFDMA transmission in 320/160+160 MHz, large size RU aggregation is allowed only within primary 160 or secondary 160, respectively**
    - **Note that primary 160 is composed of primary 80 and secondary 80 and secondary 160 is 160MHz channel other than primary 160 in 320/160+160 MHz**

**Disucssion:**

C: I also request to defer this one.

A: Ok.

**Result:**

SP deferred.

1. **11-20-0048r0 – Large RU Aggregation for 240 and 320 MHz** – Bin Tian (Qualcomm)

**Summary:** The author discussed high level thoughts on puncturing modes and proposed a number of candidate RU combination modes.

**Disucssions:**

C: In your contribution, preamble puncture seem to me is less flexible comparing to 11ax.

A: In general, for 80MHz BW, 20MHz matters. For 320MHz BW, losing 20MHz is no big deal. And complexity of holes in 320MHz is much more than in 80 MHz with way more modes.

C: We have shown some simulation results that flexible puncturing gives good benefit in throughput.

A: There are two type of interference. For dynamic interference, it comes and go, it’s ok to lose some slots and it will be good later. For incumbent users in 6GHz, we have lots of resoures now, with sufficient BW, it may be better to avoid the hard problem.

C: I do like the idea of reducing the modes of operation. Do you also have rules of maximum number of RU to combine?

A: We can do it step by step. I do not have a complete answer for now.

SP1, SP2 deferred by the author for further study.

**Straw poll 3:**

**For OFDMA in 320MHz, do you support no aggregated RU>=160 MHz except for**

* + **RU996x3**
  + **RU996x2**

**Note: RU996x3+484 (TBD)**

**Disucssion:**

**Result:**

SP deferred.

SPs on this topic will run together tomorrow.

1. **11-20-0058r2 – Preamble Puncturing for Transmission to Multiple STAs in 802.11be** – Oded Redlich (Huawei)

**Summary:** The author proposed detailed signalling method for preamble puncturing modes.

**Disucssions:**

C: You need to process 160MHz preamble to support the proposed modes. This could be a problem.

A: Yes. In order to increase the change of usage, need to obtain some information from secondary 80.

C: Why not change S80 as P80 in the case of slide 3.

A: There may have per PPDU change and not possible to change primary 80.

C: Think about 11ax, we donot indicate all the punctured channels. We only indicate the position of SIG B content channel. Are you proposing USIG to signal all puncturing modes?

A: The idea is similar as 11ax but try to enable the case with 2nd and 4th 20MHz both punctured.

**Straw poll 1:**

**Do you agree to add preamble puncturing indication about S80 for BW=160MHz in U-SIG of a PPDU transmitted to multiple users?**

**Disucssion:**

SPs deferred for tomorrow.

1. **11-20-0108r0 – Multi-RU support for OFDMA** – Sigurd Schelstraete (Quantenna/ON)

**Summary:** The author proposed possible modes for multi-RU allocation for OFDMA case.

**Disucssions:**

C: For small RU combination, there will be more extrapolation in LTF tones which may affect the performance. Also smoothing gain will be affected.

A: Need to think more.

C: Slide 14, the reasoning is questionable. CQI only feedback is not big overhead and you can decide feedback granularity.

A: If you do beamforming, need to feedback large BW with large overhead.

C: Design for 3 users is not solid. You can rotate big/small RUs in time.

A: Rate adaptation could be a problem if RU allocation change from packet to packet.

C: Equal sized RUs is not necessary. You can have time domain rotation.

A: It’s possible but then you may need to track and do rate adaption on multiple RUs.

C: Even you give same BW for each user, you still may have different MCS. BW is arbitrary rule.

A: What will driving multiple RU?

C: Mainly for DFS and incumbent user avoidance. For small RU combination there is not much use.

SPs deferred for tomorrow.

**Recess.**

**Session 6: Thursday 16 January AM1 (08:00 – 10:00)**

**Introduction**

1. The Chair calls the meeting to order at 08:00. The agenda is found in 11-20-0139r3.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the updated agenda items. Agenda approved by the group unanimously.

## Submissions

1. **11-20-0109r0 – Further considerations for multi-RU** – Sigurd Schelstraete (Quantenna/ON)

**Summary:** The author discussed signalling for Multi-RU, bit processing for EHT SIG, MCS selection for RUs and multi-RU combine with MU-MIMO.

**Disucssions:**

C: For large RU, MU-MIMO is still needed.

A: Yes, for non-OFDMA case we propose to support.

C: I think for OFMDA case also should support.

C: We want to make signalling robust and avoid multiple user field for one user. Maybe limit the RU combination modes and use some reserved field to signal combined RU.

C: The processing in slide 6 is complex for STA side.

C: On slide 7, for large RU aggregation, CQI can be different, limit to same MCS for all aggregated RUs are not efficient.

A: You need a practical way to do rate adaptation. That’s not easy in practice than in simulation.

**Result:**

SPs deferred for later today.

1. **11-20-0128r1 – Discussion on Multi-RU in 802.11be** – Oded Redlich (Huawei)

**Summary:** The author brings discussions to compare a number of alternatives to define MRU and its signalling methods. The author suggest alternative 3 or 4 with parallell alternative 5 for punctured case.

**Disucssions:**

C: What is the reason for restricting smaller RU combination within 20MHz channel?

A: Mainly for complexity considerations.

**Result:**

SPs deferred for later today.

## Pending Straw polls for Multi RU topic

**Refer to 11-20-0139r3 for SP text and SP results.**

Some discussions below:

1. **11-20-0139r3**. SP #14 (1907r1)

**Disucssions:**

C: Is there enough value for small RU combination?

A: We still have some interest in some of the modes. Just want to have limited modes for small RU combination.

1. **11-20-0139r3**. SP #50 (0022)

**Disucssions:**

C: I do not think we can decide to have a preamble puncturing pattern field. In 11ax, it is in BW field. We need to decide how many patterns we have before the signaling.

A: We defer this SP.

**Recess.**

**Session 7: Thursday 16 January AM2 10:30 – 12:30)**

**Introduction**

1. The Chair calls the meeting to order at 10:30. The agenda is found in 11-20-0139r3.
2. The Chair reviews attendance and recaps the procedures.
3. The Chair goes through the patent guidelines and asks if there is somebody that is aware of potentially essential patents. Nobody speaks up.
4. The Chair reviews the updated agenda items. Agenda approved by the group unanimously.

## Pending Straw polls

**Refer to 11-20-0139r3 for SP text and SP results.**

Some discussions below:

1. **11-20-0139r3**. SP #37 (0029)

**Discussion:**

C: Remove BW.

A: Ok.

C: Remove last 3 fields. Need more time to think.

A: Ok.

C: Coding may not need. May only support LDPC for > 20MHz

A: Keep it for now. May change later if needed.

1. **11-20-0139r3**. SP #40 (0029)

**Discussion:**

C: Remove first 3 fields.

A: Ok.

C: To be safe, change to “U-SIG or EHT SIG”. Not decide which SIG field to place the field yet.

A: Ok.

1. **11-20-0139r3**. SP3 on slide 74

**Discussion:**

C: By using a unified format, there may be additional overhead. We shall not decide now.

A: Introducing more modes outweights potential minor overhead.

## Submissions

1. **11-20-0019r0 – 11be PPDU format** – Dongguk Lim (LG)

**Summary:** The author proposed various PPDU formats for EHT PPDUs and proposed PPDU format signalling method in U-SIG.

**Straw poll 1:**

**Do you agree to add the following into the 11be SFD?**

* + **The extra 4 subcarriers are applied to L-SIG and RL-SIG.** 
    - **The indices for extra subcarriers are [-28, -27, 27, 28]**
    - **The extra subcarriers are BPSK modulated**
    - **The coefficients [-1 -1 -1 1 ] as in 11ax are mapped to the extra subcarriers**

**Disucssions:**

C: I remember we already motioned L-SIG and RL-SIG are same as 11ax, do we still need this?

A: It’s not covered and this extra tone is defined same as 11ax.

**Result:**

Y: 32

N: 0

A: 0

SP2 deferred, SP 3 withdrawn by author.

SP4 deferred.

**Straw poll 5:**

**Do you agree that one PPDU format that sent to multiple users is configured as follows?**

* + **L-STF, L-LTF, L-SIG, RL-SIG, U-SIG, EHT-SIG, EHT-STF, EHT-LTF, DATA**

****

* + - **Additional fields TBD**

**Disucssions:**

C: Some editorial change on SP text.

C: All information in EHT SIG should be version dependent. No need tohave the subbullet.

A: Ok.

**Result:**

Y: 33

N: 0

A: 1

**Straw poll 6:**

**Do you agree that EHT TB PPDU format is configured as following?**

* + **L-STF, L-LTF, L-SIG, RL-SIG, U-SIG, EHT-STF, EHT-LTF, DATA**

****

* + - **additional fields TBD**

**Disucssions:**

C: Why you donot include PE in all the figures?

A: We can add some text in motion

C: Can you defer the motion for this one? We need to think more.

C: I echo the request.

**Result:**

Y: 19

N: 2

A: 7

1. **11-20-0031r2 – Discussion on EHT PPDU Formats** – Lei Huang (Panasonic)

**Summary:** The author proposed two EHT PPDU formats: EHT Basic and EHT TB PPDU. Also proposed contents in U-SIG and EHT SIG fields.

**Disucssions:**

C: I noticed that most fields in U-SIG are copied from HE SIG A. I think we can be more creative in many fields.

A: This is example. We can think more.

SPs deferred by the author.

1. **11-20-0041r0 – Additional Overhead Reduction in Mixed BF Feedback** – Genadiy Tsodik (Huawei)

**Summary:** The author investgated the properties of mixed BF feedback and proposed an entry nulling scheme to further reduce the sounding feedback overhead with negligible or zero performance degradation.

**Disucssions:**

C: How does beamformer knows how many entries are nulled by beamformee and allocate resource for sounding feedback?

A: Beamformer can add some fields to signal number of entries or percentage to null.

C: Slide 5: If beamformee nulled several entries, this need to be signalled to beamformer.

A: Yes, some signalling is needed and still fb overhead is smaller.

C: Recomment to do smaller subband size.

C: Slide 9: For the last row, the complexity is much higher since for each subcarrier need SVD for 16x2 not Kx2 with a smaller K.

A: This is just example and I agree complexity should be considered and need carefully pick a K.

C: This proposal not work or too optimistic for some scenarios.

A: At least in some cases we have opportunities to reduce the overhead.

1. **11-20-0067r0 – Restrictions for 16 SS based MU-MIMO Scheduling** – Junghoon Suh (Huawei)

**Summary:** The author proposed to limit the per user SS to be <=4 in MU-MIMO case.

**Disucssions:**

C: Some precoder may have issue but many other precoder have no issue. In ax we limited to 4 not because of precoding.

C: You can not say you can not do it because signalling is hard.

C: Between AP, you can use like 10SSs in AP to multiple AP case.

A: This is for non-AP STA.

C: I saw simulation results showing there are gain for 10~12 SS total and 6SS per user works fine.

C: Have you considered using linear MMSE precoding?

A: Slightly better but still bad.

C: The result on slide 6, the right figure only simulate to 25 dB which is also bad in left figure.

SPs deferred by the author

1. **11-20-0080r0 – Calibration for Implicit Feedback** – Qinghua Li (Intel)

**Summary:** The author proposed a calibration method for implicit feedback and showed the simulation results.

**Disucssions:**

C: Do you need to calibrate with all STAs or just one STA?

A: Just one STA. AGC setting need to be same for calibration and data.

C: But that it’s beamformer’s responsibility, STA side should be ok.

A: Yes.

C: What about performance of other cases?

A: We show tough case with 4ss high MCS. Performance should be better with low SNR and smaller number of SS.

C: STA A is AP or non-AP STA?

A: It’s just one AP and one STA.

C: Slide 16: for LTF, how many LTF you use here?

A: We use N LTFs. N is number of Rx antenna, we use all Rx antennas to do sounding.

C: You mentioned simulation and lab test has same results but seems your settings are different for simulation and lab test right?

A: Yes.

C: Slide 16: Why much smaller than conventional veamforming feedback? You need to transmit many vectors right?

C: You transmit only 1 vector?

A: Yes. We only need to transmit 1 vector. AP has M antenna and STA only feedback Mx1 antenna.

C: You consider UL DL power difference?

A: Yes, power can be different.

SPs deferred by the author

**Adjourned at 12:30**