IEEE P802.11  
Wireless LANs

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| IEEE 802.11ba Task Group Meeting Minutes for May 2017 Meeting, Daejeon, South Korea | | | | |
| Date: 05-12-2017 | | | | |
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Abstract

Meeting Minutes for the IEEE 802.11ba TG sessions held in Daejeon, South Korea, May 7-12, 2017.

**Monday, May 8, 2017, 10:30-12:30 am**

**Meeting Agenda:**

The meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-02-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* TGba introduction
* Call for submissions
* Review agenda and approval
* IEEE 802 and 802.11 IPR Policy and procedure
* Participation in IEEE 802 Meetings
* Summary from March 2017 meeting
* Motion: March 2017 meeting minutes ([doc: IEEE 802.11-17/0526r0](https://mentor.ieee.org/802.11/dcn/17/11-17-0526-00-00ba-meeting-minutes-march-2017.docx)) and teleconference calls minutes ([doc: IEEE 802.11-17/0569r2](https://mentor.ieee.org/802.11/dcn/17/11-17-0569-02-00ba-802-11ba-teleconference-minutes-april-2017.docx))
* TGba Use Case Document review and approval
* TGba Spec Framework Document review and approval
* Presentations, Recess

**Chair Minyoung Park (Intel) calls meeting to order at 10.30 am. (**About 45 persons in the room.)

Minyoung goes through the agenda document 11-17/0545r2. The main topics for this week are:

* **Review and approve TGba Spec Framework Document (SFD)**
* **Review technical presentations**
  + Reach consensus on PHY and MAC designs for basic operation of WUR
* **Work on TGba task group documents**
  + Use case document (editor: RossYu)
  + Functional requirement document (editor: Ming Gan)
  + Evaluation methodology and simulation scenario document (editor: Shahrnaz Azizi)
  + Spec framework document (editor: Po-Kai Huang)
* **Review TG timeline**

The TG has been allocated 8 time slots this week and there are in total 48 presentations. In order to cover as many presentations as possible, Minyoung proposes to limit the discussions somewhat to give more time for the actual presentations.

Minyoung has made a proposal for the order of presentations. The priorities are based on what is essential to meet the time-line of the TG. Based on discussion of the priorities on slide 9, it is agreed to swap C and D for the MAC.

A proposal is made to have parallel PHY and MAC session, and Minyoung will check if this is possible for the July meeting. For this meeting, however, there will be no parallel sessions.

For the PHY presentations, after some discussion 11-17/697r0 Multi Sub-band Scheduling, Junghoon Suh (Huawei) is moved to category A.

Minyoung goes through the agenda for this session.

Proposal from one person to defer the straw polls until all relevant presentation have been made. Minyoung declares that this can be the procedure if requested, but this is not a default procedure.

**Motion to approve the agenda**

Move: Yunsong Yang

Second: Shahrnaz Azizi

Motion passed by unanimous consent.

Minyoung reads through the slides about *Participants, Patents, and Duty to Inform* (slide 18), *Patent Related Links* (slide 19), makes a *Call for Potentially Essential Patents* (slide 20). No potentially essential patents reported and no questions asked.

Minyoung shows *Other Guidelines for IEEE WG Meetings (slide 21), Participation in IEEE 802 Meetings (slide 22),* and where to find more relevant information (slides 23-25), and people not familiar are encouraged to read these slides.

Minyoung goes through the summary of the March meeting (slide 26). The key achievements were

* **TG elected 2 Vice-Chairs**
  + 1st VC: Yunsong Yang (Huawei): Y/N/A = 62/0/1
  + 2nd VC: Eunsung Park (LG Electronics): Y/N/A = 60/0/1
* **Reviewed technical presentations (next 5 slides)**
  + Started to reach consensus on high-level technical PHY/MAC concepts
  + TGba Spec Framework Document will be created based on the passed motions
* **Updated TGba task group documents**
  + Functional Requirements Document
  + Simulation Scenarios and Evaluation Methodology Document
* **Reviewed the TG timeline**

**Motion (slide 32)** Approve TGba minutes of March 2017 meeting [[doc: IEEE 802.11-17/0526r0](https://mentor.ieee.org/802.11/dcn/17/11-17-0185-00-00ba-meeting-minutes-january-2017.docx)] and teleconference call minutes [[doc: IEEE 802.11-17/0569r2](https://mentor.ieee.org/802.11/dcn/17/11-17-0569-02-00ba-802-11ba-teleconference-minutes-april-2017.docx)]

Move: John Notor

Second: Yunsong Yang

Motion passed by unanimous consent.

**Review of 11-17/0029r6: WUR Usage Model document (Ross Yu)**

**Question/Comment (Q):** There is no protocol allowing APs to sleep, so I wonder if this group plan to develop such a protocol. Only for 60 GHz I believe this can be done.

**Q:** I believe this possibility to let the AP be asleep should be removed.

**Q:** There has been other usage models with moving APs that also seem a bit futuristic, and may not be addressed in this TG.

**Answer(A):** I just want to emphasize that I merely document what the groups believes, and I don’t add or remove things on my own.

**Q:** When this discussion was brought up, people probably had soft APs in mind. If there is no support for procedure for AP sleep modes, then this should be removed.

**Q:** The challenge is perhaps for this group to develop something that can be used if one e.g. would have sleeping soft AP, but not develop the actual protocol itself.

**Q:** Maybe it possible to differentiate between 802.11ba capable APs and APs that are not 802.11ba capable, rather than AP and soft AP?

**Motion:** Move to approve this document (11-17/0029r7) as the draft TGba Usage Models document

Move: Ross Jian Yu

Second: James Lepp

Y/N/A: 16/10/7

Motion fails.

**Comment related to the motion:** I speak against as I read it as you within the TG would have to develop a protocol for sleeping APs, which is beyond the scope of the TG.

**Review of document 11-17/0575r0 “Specification Framework for TGba” (**Po-Kai Huang**)**

Po-Kai asks if there are any questions on the document.

**Q:** Should the negotiation phase be in the beginning of the document? The description of the operation should come first, before the negotiation description I believe.

**A:** The thinking was that negotiation happens first, this is why it is placed where it is.

**Q:** This is not the order that will be used in the specification, so please focus on the content rather than the order.

**Motion:** Move to approve the document 11-17/0575r0 as the draft TGba Specification Framework Document.

Move: Po-Kai Huang

Second: Shahrnaz Azizi

Motion passed by unanimous consent.

The received submissions for this meeting are:

**PHY presentations**:

**(A) Basic PHY performance evaluation with impairments (highest priority)**

1. 11/17-0662, “Simulated WUR Performance in Frequency Selective Channels”, Leif Wilhelmsson (Ericsson)
2. 11-17/656r0, WUR PHY performance study with phase noise and ACI, Shahrnaz Azizi (Intel)

**(B) WUR signal waveform design (signal bandwidth, OOK modulation)**

1. 11-17/659r0        On the Coexistence of 802.11ax and 802.11ba Signals      Xiaofei Wang (InterDigital)
2. 11-17-0655-00-00ba-ook-signal-bandwidth-for-wur, Eunsung Park (LGE)
3. 11-17-0703r0 Bipolar Pulse Position Modulation, Shouxing Simon Qu (BlackBerry)
4. 11-17-0704r0 Multi-Carrier OOK with Bipolar Modulation, Shouxing Simon Qu (BlackBerry)
5. 11-17/696r0 Blank GI, Junghoon Suh (Huawei)

**(C) Data rates and coding**

1. 11-17-0654-00-00ba-multiple-data-rates-for-wur, Eunsung Park (LGE)
2. 11-17/670   Data Rates and Coding, Steve Shellhammer (Qualcomm)
3. 11-17/0676r0: WUR Link Budget Follow-up: Data Rates, Rui Cao (Marvell)
4. 11-17/710r0:  Data rate value for WUR, Ming Gan (Huawei)

**(D) Preamble, packet format, and coexistence**

1. 11-17/0647r0: WUR Legacy Preamble Format Design, Rui Cao (Marvell)
2. 11-17/675 WUR Coexistence and Packet Format, Bin Tian (Qualcomm)
3. 11-17-0679-00-00ba WUR packet format and preamble design, Jianhan Liu (Mediatek)

**(F) Further optimizations (lowest priority)**

1. 11-17/697r0 Multi Sub-band Scheduling, Junghoon Suh (Huawei)

**MAC presentations**:

**(A) Basic unicast wake-up packet transmit/receive operation (highest priority)**

1. SP: 11-17-0379-01-00ba-sfd-mac-proposal, Suhwook Kim (LGE)
2. 11-17-0652-00-00ba Consideration of EDCA for WUR Signal, Po-Kai Huang (Intel)
3. 11-17-0653-00-00ba Examples of Integrating WUR with Existing Power Save Protocol, Po-Kai Huang (Intel)
4. 11-17/716, WUR with conventional 802.11 power save, Jinsoo Ahn (Yonsei Univ.)
5. 17/0685r0, Efficient WUR mode signaling, Lei Huang (Panasonic)
6. 11-17/695, WUR acknowledgement indication, Kaiying Lv (ZTE)
7. 11-17-0717-00-00ba WUR retransmission procedure, Hanseul Hong (Yonsei Univ.)

**(B) Basic WUR Beacon operation**

1. SP: 11-17-0382/r0, WUR Reference Signal, Woojin Ahn (Wilus)
2. SP: 11-17/447, Synchronization with Low Power Antenna, Liwen Chu (Marvell)
3. 11-17/671   Considerations on WUR Synchronization, Steve Shellhammer (Qualcomm)
4. 11-17-0651-00-00ba Indication for WUR Duty Cycle, Po-Kai Huang (Intel)

**C) Multicast wake-up packet transmit/receive operation**

1. SP: 17/381, WUR MAC issues follow-up( for Straw Polls), Jeongki Kim, (LGE)
2. 11-17-0630-00-00ba-SFD-Proposal-on-Retransmission, Suhwook Kim (LGE)
3. 11-17-0658-00-00ba, Review of Multi-user Wakeup Schemes, Yong CHENG, Huawei Device

**(D) Wake-up packet, information element format and content**

1. SP: 11-17-0380-00-00ba-wur-channel-switch, Suhwook Kim (LGE)
2. SP: 11-17/387, Purpose Indication for WUR Packets, Xiaofei Wang (InterDigital)
3. 11-17/673 Encoding for Elements in WUR, James Lepp (BlackBerry)
4. 11-17/674 Additional Elements for WUR, James Lepp (BlackBerry)
5. 11-17-0681-00-00ba, WUR wake-signal update-follow up, Jianhan Liu (Mediatek)
6. 11-17/680 Content of WUP, Tianyu Wu, (Mediatek)
7. 11-17/642, Wake Up Frame Follow up, Liwen Chu (Marvell)
8. 11-17/641, Wake Up Frame Length, Liwen Chu (Marvell)

**(E) Security**

1. 11-17/0660, WUR Security Proposal, Yunbo Han, Huawei
2. 11-17/0411r0 consideration of WUR security, Kaiying Lv (ZTE)

**(F) Further optimizations (lowest priority)**

1. SP: 11-17/437, BSS Management through WUR Wakeup Frame, Liwen Chu (Marvell)
2. SP: 11-17/68r1, AP discovery discussion, Kaiying Lv (ZTE)
3. 11-17/657, AP re-discovery in WUR, Jeongki Kim, LG Electronics
4. 11-17/440, Inter-BSS Communication, Liwen Chu (Marvell)
5. 11-17/728, AP Power Saving, Xiaofei Wang (InterDigital)

**Motions (Thursday AM1)**:

1. 11-17/668   Motion on Manchester Coding, Steve Shellhammer (Qualcomm)

**Task group documents**:

1. 11/17-029r6 WUR Usage Model Document, Ross Yu (Huawei) – Monday AM2
2. 11/17-575r0 TGba Spec Framework Document, Po-Kai Huang (Intel) – Monday AM2
3. 11-17/188r?: Simulation scenarios evaluation methodology document, Shahrnaz Azizi (Intel)

**Presentations:**

**11/17-0662, “Simulated WUR Performance in Frequency Selective Channels”, Leif Wilhelmsson (Ericsson):** The presentation is concerned with how a frequency selective channel impacts the performance of the wake-up signal. The findings are that the ISI caused by the channel is not an issue, but because of the smaller bandwidth of the wake-up signal compared to the actual data signal, a larger fading margin may be needed. The fact that ISI is not an issue is consistent with the rule-of-thumb that ISI should not be a problem as long as the RMS delay spread is less than 10% of the symbol duration, which for the wake-up packet was assumed to be 4 us.

**Minyoung declares the group to be in recess at 12.30 pm.**

**Monday, May 8, 2017, 1:30-3:30 pm**

The meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-03-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Presentations
* Recess

**Minyoung calls meeting to order at 1.30 pm.** (About 80 people in the room.)

Minyoung asks for essential patents. No potentially essential patents reported and no questions asked.

**Presentations:**

**11-17/0656r0 “WUR PHY performance study with phase noise and ACI”, Shahrnaz Azizi (Intel):** The presentation is concerned with how phase noise impact the performance in general, and ACI in particular. The phase noise model used is the one agreed by the group.

**Q:** Slide 12, this shows the importance of operating in the middle of the band.

**Q:** I don’t think there will be such a big difference regarding ACI as indicated on page 12 if you apply a reasonable filter.

**A:** We applied a very simple filter to allow for simple implementation.

**11-17/0697r0 “Multi Sub-band Scheduling”, Junghoon Suh (Huawei):** The presentation considers the feasibility to transmit three wake-up signals within a 20 MHz channel by means of frequency multiplexing.

**Q:** The idea why we wanted a 4 MHz receiver was power consumption, but it seems you are now going back to 20 MHz.

**Q:** I believe the RX architecture should actually be for a single 4 MHz channel, you would then receive similar performance.

**Q:** In the choice of LPF, you say that it is a trade-off between power consumption and performance. However, since your LPF is digital I wonder if the power consumption really is an issue.

**11-17/0655r0 “OOK Signal Bandwidth for WUR”, Eunsung Park (LGE):** The presentation shows simulation results for various bandwidths of the wake-up signal in the range 1-5 MHz.

**Straw Poll 1:**

* Do you agree to add the following to the 11ba SFD?
  + The OOK waveform of wake-up packet is generated by populating thirteen 802.11 OFDM subcarriers including DC.

Questions on the Straw Poll:

**Q:** Thirteen tones including the DC?

A: Yes.

**Q:** I don’t think the specification should define how a waveform is generated, only what the waveform should look like.

**Y/N/A:** 21/1/29

**Straw Poll #2**

* Do you agree to add the following to the 11ba SFD?
  + For the transmission of a wake-up packet using one sub-band, the OOK waveform of wake-up packet is generated by populating 802.11 OFDM subcarriers with the sub-carrier spacing of 312.5 kHz from -6 to 6.

Question on the Straw Poll:

Q: How about generating the signal when it is not centered at DC?

A: We are only considering generation of one wake-up signal, and then the proposal is that it is centered around DC.

**Y/N/A: 13/7/29**

**11-17/0703r1 “Bipolar Pulse Position Modulation**”, **Shouxing Simon Qu (BlackBerry):** The presentation is made Stephen McCann. The presentation proposes bipolar PPM as a means to obtain a narrower spectrum of the wake-up signal.

**Q:** You are proposing a single carrier solution rather than multi-carrier modulation?

**A:** We consider multi-carrier modulation in the next presentation.

**Q:** Normally spectrum efficiency is very important, but for the wake-up signal we are already discussing using 4 MHz for transmitting a data rate of 250kb/s. Given spectrum regulations on TX power is may even be desirable to have a sufficiently larger bandwidth.

**11-17/0704r0 “Multi-Carrier OOK with Bipolar Modulation”, Shouxing Simon Qu (BlackBerry):** The presentation is made Stephen McCann. The presentation is essentially a continuation of 11/17-0703r1, where the results now are extended to multi-carrier modulation.

**Q:** It would be good to see simulation results with respect to what gain can be expected.

**Q:** For the multi-carrier case I can intuitively not see why there should be a large gain.

**Straw Poll:** Should Multi-Carrier OOK with Bipolar Modulation be considered for the Specification Framework document?

**Y/N/A:** 4/3/37

**11-17/0696r0 “Blank GI for the Waveform Coding”, Junghoon Suh (Huawei):** The contribution proposed to blank out the GI, i.e., not sending anything there and in that way save in terms of transmitted power. In the receiver, the processing is then done after discarding the GI.

**Q:** On slide 3, it looks like a ”1” has less energy. Also, at the WUR there is no need to remove the CP. Finally, I don’t think the channel is a problem, it becomes a problem you convolve it with the receiver filter.

**A:** I don’t agree, I think the channel is a problem.

**Q:** For WUR we don’t need the 4us, 3.2us is enough.

**A:** But without GI you will suffer from ISI.

**Minyoung declares the group to be in recess at 3.30 pm.**

**Monday, May 8, 2017, 7:30-9:30 pm**

**Meeting Agenda:**

The meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-04-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Presentations
* Recess

**Minyoung calls meeting to order 7.35 pm.** (About 40 people in the room.)

Minyoung asks for essential patents. No potentially essential patents reported and no questions asked.

**11/17-0379r2 “SFD MAC Proposal”, Suhwook Kim (LGE):**

**Q:** You use the term initiating, but is it actually negotiating?

**A:** No, it is as illustrated on page 4.

**Q:** It sounds that you negotiate these parameters every time you enter the WUR mode?

**A:** Yes. But maybe not all parameters need to be negotiated.

**Q:** I think it is too early to have this straw poll. We have some ideas for how to integrate with the current protocols available in 802.11. I believe it is better to discuss these ideas first.

**Q:** I have concern with the notion of an explicit Wake-Up mode and that the word shall is used. I suggest you may change this to something like a method, which may be either explicit or implicit.

**Straw Poll 1: (WUR Mode signaling)**

Do you support following sentences?

* + Explicit Wake-Up mode initiation signaling shall be defined for the WUR STA to enter WUR mode
  + Wake-Up operating parameter may be negotiated during Wake-Up mode initiation signaling
    - Detail parameters are TBD

**Y/N/A:** 12/2/11

**Straw Poll 2:**

Do you support following sentence?

* The channel where wake-up signal is sent is located within the primary 20MHz channel of primary connectivity radio

**Y/N/A:** 8/4/13

**11/17-0653r0 “Examples of Integrating WUR with Existing Power Save Protocol”, Po-Kai Huang (Intel):** The presentation is about reuse of protocols already existing within 802.11. These existing protocols are categorized as:

* Power save protocols without existing negotiated service period
  + Examples include PSM, PSP, and U-APSD
* Power save protocols with existing negotiated service period
  + Examples include TWT, as discussed in 11ax/ah, and WNM sleep mode

Future design should consider the following features:

* Have signaling to enable/disable WUR operation
* Suspend existing MR negotiated schedule rather than terminate existing MR negotiated schedule when entering WUR operation
* Resume only one existing MR negotiated schedule/service period after receiving wake-up packet
* Preserve the existing sequence exchange for power save protocols without negotiated schedule such as PSM, PSP, and U-APSD and enter WUR operation after sequence exchange ends

**Q:** I think some of the discussed protocols may be too much of a burden for a WUR.

**A:** We are not saying you need to implement all protocols, rather that we want to reuse as much as possible.

**Q:** The enable and disable features are new.

**A:** Yes they are, but we believe these features are important and can be justified.

**Q:** Do you expect that the WUR can be ON also when the primary radio is ON?

**A:** The main radio should be off, i.e., in doze mode. But again, the questions need to be discussed more and this is why I don’t have any straw polls at this point in time.

**Q:** It seems it is only in the example on page 5 that the STA does not acknowledge the reception of a wake-up packet.

**11/17-0652r0 “Consideration of EDCA for WUR Signal,” Po-Kai Huang (Intel):** The contribution proposes to reuse existing AC and EDCA categories to transmit wake-up packet. The AP may use any AC to send a wake-up packet to a STA.

Concerning CW and retry, it is proposed that the CW should not be updated in case of failure since the transmission opportunities are so rare, and the channel conditions then may have changed anyway.

**Q:** Can you elaborate on reference 2 on page 6 and the 10 ms you mention?

**A:** In [2], which is the simulation scenario document for 11ax, it was assumed that it takes 10 ms to transition from deep sleep to active mode for the STA, so this is the reason why no new wake-up signal can be sent earlier.

**Q:** Why do you propose any AC for the WUR beacon, isn’t the beacon a very important packet?

**A:** The proposal does not exclude to use the highest AC. This is mainly to simplify the specification work.

**Straw Poll 1:**

* Do you support the following?
  + An AP reuses existing 4 ACs and corresponding EDCA parameters to transmit WUR signal
  + Note that WUR signal includes unicast wake-up packet, multicast wake-up packet, and WUR Beacon

**Y/N/A:** 21/0/4

**Straw Poll 2:**

* Do you support the following?
  + An AP may use any AC for sending a multicast wake-up packet
  + An AP may use any AC for sending a WUR Beacon

**Y/N/A:** 20/1/4

**Straw Poll 3:**

* Do you support the following?
  + An AP may use any AC for sending a unicast wake-up packet to a STA if the AP does not have pending buffered frame to the STA

**Y/N/A:** 10/0/15

**Straw Poll 4:**

* Do you support the following?
  + After an AP sends a WUR signal using EDCAF of a particular AC, the AP shall not update CW and retry count of the AC
  + After identifying failure for an unicast wake-up packet that is sent using EDCAF of a particular AC, AP shall not update CW and retry count of the AC

**Y/N/A:** 10/0/19

**11-17/0716r1 “WUR with conventional 802.11 power save”, Jinsoo Ahn (Yonsei Univ.):** The contribution described how already available procedures in 802.11 can be reused, both for unicast and multicast.

**Q:** You say this is one way, but there may be options?

**A:** Yes.

**Straw Poll:**

* Do you agree to add the followings to 802.11ba SFD?
  + 802.11ba should be able to be operated with the conventional 802.11 power save procedures.

**Y/N/A:** 13/3/15

**11-17/0685r0, “Efficient WUR mode signaling”, Lei Huang (Panasonic):** The presentation considers what signaling is needed to e.g. negotiate different parameters for WUR operation.

**Q:** On slide 6, what happens if the AP wakes up multiple STAs, do you have any ideas?

**Q:** On slide 9, it appears the legacy STAs will not recognize this packet, so it will impact the legacy STAs.

**Q:** On slide 3, I don’t think you need these separate request responses, at least not all the time.

**A:** This is just an example with a piggy-backed mode.

**Q:** I think it is a good idea, but the consequences need to be considered more. Specifically, when packets are not correctly received, error recovery may be more complicated.

**Straw Polls withdrawn.**

**11-17/0695r2 “WUR acknowledgement indication”, Kaiying Lv (ZTE):** The presentation is concerned with the situation when many STAs are woken up by, and the corresponding contention for sending the response to the WUP. In particular, if it many STAs are expected to wake up, it may be better that they don’t contend for the channel directly but instead wait to be triggered by the AP.

**Straw Poll 1**

Do you support that an indication shall be carried in the wake-up packet to indicate whether a Trigger frame will be sent to trigger the acknowledgement?

**Y/N/A:** 19/0/9

**Straw Poll 2**

Do you support that an indication may be carried in the wake-up packet to recommend the AC of the acknowledgement or transmission?

**Y/N/A:** 8/2/23

**Minyoung declares the group to be in recess at 9.40 pm.**

**Tuesday, May 9, 2017, 10:30-12:30 am**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-05-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Presentations, Recess

**Chair Minyoung Park (Intel) calls meeting to order at 10.30 am. (**About 50 persons in the room.)

Minyoung reminds about attendance.

Minyoung makes a call for potential essential patents. No potentially essential patents reported and no questions asked.

**Presentations:**

**11-17/0659r0, “On the Coexistence of 802.11ax and 802.11ba Signals”, Xiaofei Wang (InterDigital):** The presentation is made by Rui Yang. The contribution is concerned with concurrent transmission of 802.11ax and 802.11ba when the symbol rate of 802.11ba is higher than the OFDM symbol rate of 802.11ax so that the signal would not be orthogonal if generated using IFFTs. To achieve orthogonality, DFT-spread OFDM is proposed.

**Q:** Is the CP also added to the OOK signal?

**A:** Yes.

**Q:** Do you propose one or more wake-up signals?

**A:** Only one 802.11ba signal. but multiplexed with 802.11ax in this example. However, this can be generalized to more wake-up signals.

**Q:** What does the sequences look like?

**A:** This is described on page 10.

**Q:** On page 13, the 802.11ax and 802.11ba are very close in frequency. I am surprised the performance is so good, with essentially no impact of 802.11ax interference.

**Q:** What about the impact on 802.11?

**A:** This is very small, as shown on page 14.

**Straw Poll 1:**

Do you agree that TG11ba should consider the concurrent 11ax signal and WUS transmission?

**Y/N/A:** 11/0/21

**Straw Poll 2:**

Do you agree that TGba should investigate on WUR waveform designs as a part of 11ax OFDMA transmissions?

**Y/N/A:** 5/0/24

**Straw Poll 3:**

Do you agree that the TGba should further study sequence-based OOK symbols as a 11ba PHY design?

* to allow concurrent transmission of 11ax signal and WUS
* to have increased WUR coverage range

**Y/N/A:** 6/1/23

**11/17-0654r2“Multiple Data Rates for WUR”, Eunsung Park (LGE):** The presentation discusses the need for multiple data rates and also present simulation results for the performance for some possible data rates. The data considered data rates are in the range of 125 kb/s to 1 Mb/s.

**Straw Poll 1:** Do you agree to add the following to the 11ba SFD?

* 11ba supports multiple data rates for the payload part of the wake-up packet

**Y/N/A:** 24/0/5

**Straw Poll 3:** Do you agree to add the following to the 11ba SFD?

* 11ba uses the Manchester code for all of the data rates for the payload part of the wake-up packet

**Y/N/A:** 11/0/14

**11-17/0670r0 “Data Rates and Coding”, Steve Shellhammer (Qualcomm):** Based on regulatory restrictions and increased NF, 12 to 15dB better link budget may be needed. This presentation studies different schemes to see if it is feasible to obtain sufficiently good sensitivity to compensate for this. The approach is to consider relatively low data rates, 31.25 kb/s – 250 kb/s, using Manchester coding as well as BCC.

**Q:** The 1 Mb/s in your comparison comes from 802.11b?

**A:** Yes, or pre-11b if you like.

**Q:** Do you need to compare to that?

**A:** We sell a lot of 11b, so we believe it makes sense.

**Q:** The memory in your BCC decoder increases power consumption also because of leakage since there in increased memory.

**A:** I agree.

**Q:** There may also be OBSS interference, so the WUR may detect a wake-up packets from other BSS and then the BCC decoder may run more often.

**A:** Could be, but I envision that we would be using duty cycling and then if the BSSs are not synchronized it may not be a problem.

**Q:** The SNR values you use are based on 20 MHz bandwidth?

**A:** Yes.

**Q:** How many are actually using 802.11b and 1 Mb/s?

**A:** Even if much higher data rates are used most of the time, it is supported and it should also be possible to use with a WUR.

**Q:** I agree that a BCC can improve the performance, but I would like to know how much power the BCC consumes.

**A:** I don’t have any numbers, but considerably less than the 100 uW that is consumed by the RF.

**Q:** I am concerned with the you don’t have a high enough data rate to effectively support situations with high SNR.

**A:** I agree in principle. I have focused on the low SNR region.

**Q:** I also agree with the idea that three data rates seems reasonable.

**11-17/0676r0: WUR Link Budget Follow-up: Data Rates, Rui Cao (Marvell):** The contribution is presented by Hongyuan Zhang. The considered data rates are 125,250,500,1000 kb/s.

**Q:** I agree with you that we need higher data rates.

**Q:** You only want 2 bits for packet length. I don’t think this is enough.

**A:** It is based on input from our MAC people.

**Q:** I like the idea of a few bits to indicate packet length and also some kind of error check.

**Minyoung declares the meeting to be in recess at 12.38 pm.**

**Tuesday, May 9, 2017, 1:30-3:30 pm**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-05-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Presentations
* Recess

**Chair Minyoung Park (Intel) calls meeting to order at 1.30 pm. (**About 80 persons in the room.)

Minyoung reminds about attendance.

Minyoung makes a call for potential essential patents. No potentially essential patents reported and no questions asked.

**Presentations:**

**11-17/0717r0 “WUR retransmission procedure”, Hanseul Hong (Yonsei Univ.):**

**Q:** On slide 8, you assume that the main radio can decode the wake-up packet?

**A:** Yes.

**Q:** Since very different modulations are used for the WUR and the main radio, I don’t believe the main receiver can be used. Also, if the main receiver is already on, there is no need to send a wake-up packet.

**Straw Poll 1:**

Do you agree to add the followings to 802.11 ba SFD?

* When a response frame to a wake-up packet by the unicast transmission is not required, 802.11ba AP may check the STAs’ status using the primary connectivity radio before the retransmission of wake-up frame.

**Y/N/A: 3/0/30**

**11-17/0447r1 “Synchronization with Low Power Antenna”, Liwen Chu (Marvell):**

**Q:** In Option 2, whenever you do synchronization, you need to wake up the main radio?

**A:** Yes

**Q:** How is the relation between the TSF Time and LP TSF Time if for instance the former is 64 bits and the latter 32 bots?

**A:** The granularity is larger if the number of bits is less.

**Straw Poll 1:**

Which one do you pref.

* + 1), LP TSF time adjustment through LP WUR only.
  + 2), LP TSF Time Adjustment through LP WUR and .11 management frame.

**1/2:** 16/4

**Straw Poll 2: Straw Poll deferred.**

**11-17/0671 “Considerations on WUR Synchronization”, Steve Shellhammer (Qualcomm):** The contribution discusses the trade of in synchronizing using the beacon timing or (partial) TSF, and essentially proposes a compromise where a partial TSF, e.g. 1 byte, is used.

**Q:** You are proposing 1 byte, would it not suffice with less, say 3-4 bits.

**A:** 1 byte was selected mainly for convenience. If people responsible for the MAC are fine with fractions of a byte that is fine as well.

**Q:** You say that one octet partial TSF is sufficient, how do you get to this conclusion?

**A:** This is based on handling 200 ppm drift, reasonable power consumption, and a 10 second beacon interval.

**Straw Poll:**

Do you support the following?

* WUR beacon frame can carry partial TSF for synchronization

**Y/N/A:** 23/0/17

**11-17/0651r1 “Indication of WUR Duty Cycle”, Po-Kai Huang (Intel):** The contribution is concerned with the WUR duty cycle schedule indication. It is proposed that:

* + AP indicates the basic unit for the period of WUR duty cycle
  + AP Indicates minimum wake-up duration for each WUR duty cycle schedule
  + AP decides starting point
  + STA negotiates on duration and period

**Q:** On slide 5, can you elaborate on the relation between the beacon time and the parameter T?

**A:** An example could be that the beacon interval is 10 s, whereas the period T is maybe 100 ms.

**Q:** How can you do multicast if the duty cycles are not synchronized?

**A:** The AP would in case of multi-cast align the starting point for the respective STAs.

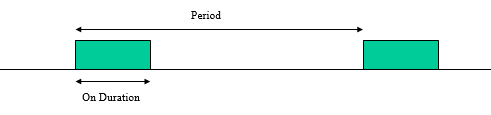
**Q:** On slide 5, the AP indicated the minimum wake-up duration, but the STA is also involved?

**A:** The AP and the STA negotiate using a request-response procedure.

**Straw Poll 1:**

Do you support the following?

* The period of the WUR duty cycle as shown below is a multiple of a basic unit
* The basic unit is indicated by the AP

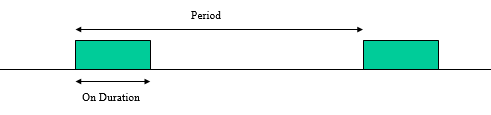


**Y/N/A:** 32/0/17

**Straw Poll 2:**

Do you support the following?

* The on duration in each period for WUR duty cycle as shown below is larger than or equal to a minimum wake-up duration
* The minimum wake-up duration is indicated by the AP



**Y/N/A:** 16/2/22

**Straw Poll 3:** Move to add the following to 11ba SFD:

* AP decides the starting point for one WUR duty cycle schedule
* How to indicate the starting point is TBD

**Y/N/A:** 20/0/20

**11-17/0380r0 “WUR channel switch”, Suhwook Kim (LGE):** The contribution is concerned with the situation when the main radio switches to another primary channel, and how to inform the WUR about this. In particular, the options of whether to send the information over the WUR interface or over the WLAN interface are discussed.

**Q:** Do you mean the channel for primary radio or the WUR?

**A:** The primary radio.

**Q:** If the primary radio changes channel what happens with the WUR channel?

**A:** It is assumed the WUR is on the same, so no explicit information is needed regarding this.

**Straw Poll 1:**

Do you support following sentences?

* 11ba spec shall define a mechanism to indicate channel switch information for WUR STA

**Y/N/A:** 16/0/26

**Straw Poll 2:**

Do you support following sentences?

* 11ba spec shall define a mechanism to indicate channel switch information for WUR STA and that channel switch information can be delivered on primary connectivity radio

**Y/N/A:** 10/1/34

**Straw Poll 3:** Do you support following sentences?

* 11ba spec shall define a mechanism to indicate channel switch information for WUR STA and that channel switch information can be delivered in Wake-Up frame

**Straw Poll withdrawn**

**11-17/0387r1 “Purpose Indication for WUR Packets”, Xiaofei Wang (InterDigital):** The contribution discusses the benefits that can be achieved if there is information in the WUP which indicates the purpose, e.g. synchronization, to send UL data, or to be prepared to receive DL data.

**Q:** What kind of information is this?

**A:** It can probably be viewed as control information.

**Q:** In scenario 4, do you assume that the AP is asleep? **A:** Yes.

**Q:** In Scenario 5, there is a tendency to pack a lot of MAC features in the WUP. I am a bit concerned as the WUP may not be very robust.

**Q:** What kind of categories do you need in addition to the actual wake-up and synchronization?

**A:** An example could be whether the STA should wake up for TX or RX.

**Straw Poll:** Do you agree that a wake up packet should include a purpose field to indicate the purpose of the wake up operation?

**Y/N/A:** 18/3/29

**Minyoung declares the meeting to be in recess at 3.29 pm.**

**Wednesday, May 10, 2017, 8:00-10:00 am**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-06-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Presentations
* Recess

**Chair Minyoung Park (Intel) calls meeting to order at 8.00 am. (**About 35 persons in the room.)

Minyoung reminds about attendance.

Minyoung makes a call for potential essential patents. No potentially essential patents reported and no questions asked.

**Presentations:**

**11-17/710r1 “Data rate value for WUR”, Ming Gan (Huawei):**

**Q:** On page 6, I believe the 3 dB loss for OOK is too optimistic, I expect something like 5-6 dB.

**Q:** On page 6, when you state that we should not have 1 Mb/s as base line, you mean that 1 Mb/s should not be supported?

**Q:** On page 6, I don’t think 1.5 ms transmission every 10 s is very bad.

**Q:** With the range on page 5, why don’t you even propose higher data rate?

**A:** We are open for higher data rate.

**Q:** I don’t agree with your link budget calculation, I believe the coverage is much worse.

**11-17/0647r3 “WUR Legacy Preamble Format Design, Rui Cao (Marvell):** The contribution is presented by Hongyuan Zhang. The presentation is concerned with that 802.11n devices may have high false alarm probability for WUR packets. This issue can be addressed with PHY design by adding an extra OFDM symbol using BPSK before the narrow-band WUR symbol.

**Q:** You say we don’t need to standardize this, but at least we need to avoid it is mistaken for L-SIG.

**A:** I agree, maybe we need to standardize it, at least to some extent.

**Q:** The symbol is just a dummy symbol that does not carry any data?

**A:** Yes, that is correct. It is only to spoof the legacy 802.11n devices.

**Q:** I agree that this symbol should be BPSK, but regarding not specifying this signal I think that may not be good.

**A:** I agree. This is similar to a previous comment.

**Q:** The scope of the TG is not to decide on the content of such a signal.

**Straw Poll:**

Do you agree to have L-STF, L-LTF, add L-SIG appended in 11ba packets, and add an extra full-bandwidth (20MHz) OFDM symbol with BPSK modulation after LSIG in the 11ba packets to spoof legacy devices?

**Y/N/A:** 21/0/4

**11-17/0675r0 “WUR Coexistence and Packet Format”, Bin Tian (Qualcomm):** The presentation discusses two means to protect the WUP, L-SIG or CTS. The discussion about L-SIG is very aligned with 11-17/0647r3.

**Q:** I like the idea of using the CTS.

**A:** The question is more if you want to have packet format without legacy preamble as well.

**Q:** Maybe it is better to indicated STA ID than the BSS color?

**A:** I believe there is a trend in 802.11 to indicated from what AP the packet is sent, so using BSS color would be more aligned with how things are typically done today.

**Q:** On slide 3, what do you mean with AGC setting?

**A:** It is a very coarse AGC, and even if the preamble is 7 dB stronger it is probably good enough for the required AGC accuracy.

**Q:** How can you set the AGC before the WUP is detected?

**A:** I believe this is too detailed and goes in to how things are implemented.

**Q:** Regarding the design of the symbol, maybe there are better alternatives?

**A:** I am open for suggestions.

**11/17-0679r2 “WUR packet format and preamble design”, Jianhan Liu (Mediatek):**

**Q:** For the signature sequence, it does not have to be bits, you just run the correlator.

A: In principle, but in my mind we should use OOK. However, it is up to the group.

**Q:** How long is the signature sequence.

**A:** I did not say, maybe around 10 bits.

**Q:** If the signature is used to indicate the data rate, you must look for different signatures?

**A:** Yes, but it is very simple.

**Q:** The preamble design is classical design, used in e.g. Zigbee and Bluetooth. How long is the AGC sync sequence?

**A:** 6 bits.

**Q:** I like the idea of removing the SIG field and instead including the information in the signature sequence.

**Q:** About the AGC synchronization sequence, is that the sequence or the wave-form.

**A:** It is the synchronization sequence, which is without Manchester coding.

**Q:** How many rates do you want to detect?

**A:** 2 or 3.

**Q:** On slide 4, is control information just MAC data?

**A:** Yes.

**Q:** You have a question mark for the SIG field, what is your opinion?

**A:** I am open to that, but it should have the same data rate as the control information.

**Straw Poll 2:**

Do you agree to use different signature sequence to indicate the different data rate?

The detailed signature sequence is TBD.

**Y/N/A:** 8/1/25

**Straw Poll 1:**

Do you agree that the AGC/Sync sequence shall be OOK modulated using a sequence with alternative “1” and “0”, such as “1 0 1 0 …”?

* + The length of the sequence is TBD.

**Y/N/A:** 8/0/26

**Minyoung declares the meeting to be in recess at 10.00 am.**

**Wednesday, May 10, 2017, 4:00-6:00 pm**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-07-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Presentations
* Recess

**Chair Minyoung Park (Intel) calls meeting to order at 4.00 pm. (**About 25 persons in the room.)

Minyoung reminds about attendance.

Minyoung makes a call for potential essential patents. No potentially essential patents reported and no questions asked.

Minyoung goes through the agenda, including the two added time-slots, and asks if there is any comment or objection to approve the agenda. No response.

**Presentations:**

**11-17/0673r0 “Encoding of Elements in WUR Wake-up Trigger Frame”, James Lepp (BlackBerry):**

**Q:** So far we have only talked about two types, i.e., Beacon and wake-up packets. What do you get for these bits allowing you to have large number of different types?

**A:** This is more about what to put in the beacon, rather than what packet type it is. I will develop this further in the next presentation.

**Q:** You say information element. Information element has a certain meaning in IEEE 802.11, is that the information element you mean? Also, this is a rather long, which may not be desirable with the low data rate for the wake-up signal.

**A:** Yes, it is the information element, but the thinking here is that the beacon is sent less frequently so that the length would be OK. The question I have to the group is actually if we should reuse the common TLV format, or if we should develop a compressed format for the WUR.

**Q:** You said we need to develop the contents, and I believe this is what we should start with. First understand what needs to go in the packet, and then we can discuss how to format it.

**A:** I basically agree.

**Q:** You don’t actually proposing using the TLV?

**A:** No, I just want to start the discussion and make people think about the issue.

**Straw Poll 1:**

Should WUR Wake-up Trigger Frame use elements with the common 802.11 TLV format?

1. Use the TLV style for elements similar to Beacons/Probes etc.
2. Use something else for encoding elements
3. Abstain

**1/2/3:** 1/14/6

**11-17/0674r0 “Additional Elements for WUR”, James Lepp (BlackBerry):** The contribution is concerned with that up until now the discussed addresses in the WUP is only the transmitter address and the receiver address, whereas including the sources address has not been discussed at all. In addition, the impact of using shortened identifiers instead of the full MAC address in case of multicast and broadcast is discussed.

**Q:** On slide 5, if the STA decides it is not worth waking up and the AP believes it should, it just keep resending the wake-up packet.

**A:** Needs more thinking, but it is similar as if the wake-up packet would be interfered.

**Q:** Does the AP need to transmit all WUP?

**A:** It is in principle possible for the AP to do the filtering, but I am not sure if this is supported for 802.11.

**Q:** One solution seems to be that you use group addressing rather than broadcasting?

**A:** Yes, actually this is also aligned with my thinking.

**Q:** I see a WUR as a very simple device that basically only wakes up the main receiver and then the logic takes place in the main receiver. Does this filtering you propose add a lot of complexity to the WUR? I would prefer to use a group address, and let the logic be in the AP.

**A:** I agree that it adds logics, but it is very simple logic. It is essentially just comparing with what is in a “white list”. I believe it is good to have this possibility for making this decision in the STA.

**Q:** I also believe it may be a bit dangerous to let the AP decides autonomously whether to wake up or not.

**Q:** I believe you bring up a very relevant problem, but I believe the solution you propose is very costly. I believe we should look for other solutions, like only sending unicast.

**Q:** On slide 10, do you propose that if the AP receives a broadcast data packet, it has to first send a broadcast WUP?

**A:** Yes, this is what I have seen in some presentation.

**11-17/0681r0 “Follow-up on Update Wake-Up Information in WLAN with Wake-Up Radio Receivers”, Jianhan Liu (Mediatek):**

**Q:** What kind of information will be delivered in the WUR signal packet on page 5?

**A:** I did not say. Basically any information that needs to be updated.

**Q:** I assume this is done using the primary connectivity radio?

**A:** Of course.

**Q:** With sequence you don’t mean the sequence one is correlating against?

**A:** Correct.

**Q:** How often do you expect this to happen?

**A:** I don’t know, maybe never. I can’t really predict but I expect that it will not be very often.

**Q:** Is this management messages?

**A:** Yes.

**Q:** Do we need to do anything new, or does this already exist?

**A:** It already exists in 802.11. It is just a sequence exchange.

**Straw Poll 2:**

Do you agree with the packet exchange sequence for information (related to wake-up receiver) update shown in slide #5?

* The detailed frame formats are TBD.

**Y/N/A:** 8/4/13

**11-17/0680r2 “Content of WUP”, Tianyu Wu (Mediatek):** Both beacon and single user addressed WUP

**Q:** Performance-wise, it is better to have one strong CRC than several small ones if the total number of total CRC bits is the same.

**Q:** On slide 6, is this unicast or a group packet.

**A:** It can be unicast or group packets. One can select to decode if it is needed to synchronize to the AP.

**Q:** I think you are adding a lot of things that may not be used, but take potentially quite some time to transmit.

**Q:** I think it is good idea with several segments, but maybe not too many.

**A:** I agree.

**Straw Poll 1:**

Do you support to allow fields in SU/group addressed WUP appending to the WUR beacon?

* Detailed fields TBD

**Straw Poll deferred**

**Straw Poll 2**

Do you support to include access category field in TBD type of wake up packets?

* The access category field indicates the highest AC of the queuing data for the target WUR STA

**Y/N/A:** 4/2/16

**Straw Poll 4:**

Do you support to include per user fields in group addressed WUPs?

* Content in per user fields TBD.

**Y/N/A:** 5/3/17

**Straw Poll 5:**

Do you support to use multiple FCSs to separately check the segments of a WUP?

* WUP segmentation details TBD

**Y/N/A:** 4/2/19

**Minyoung declares the meeting to be in recess at 6.02 pm.**

**Thursday, March 16, 2017, 8:00-10:00 am**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-08-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Motions
* Presentations
* Recess

**Chair Minyoung Park (Intel) calls meeting to order at 8.05 am. (**About 65 persons in the room.)

Minyoung remindes about the attendance and goes through the agenda.

Minyoung makes a call for potentially essential patents. No response.

The scheduled motions are shown in the list below:

1. 11-17/668   Motion on Manchester Coding, Steve Shellhammer (Qualcomm) (SP:31/10/22)
2. 11-17/647r3 WUR Legacy Preamble Design, Hongyuan Zhang (Marvell) (SP:21/0/4)
3. 11-17/716r2 WUR with conventional 802.11 power save, Jinsoo Ahn (Yonsei Univ.) (SP: 13/3/15)
4. 11-17-0654-02-00ba-multiple-data-rates-for-wur, Eunsung Park (LGE) (SP1: 24/0/5, SP3: 11/0/14)
5. 11-17-0655-01-00ba-ook-signal-bandwidth-for-wur, Eunsung Park (LGE) (SP: 21/0/19)
6. 11-17-0651-01-00ba-indication-for-wur-duty-cycle, Po-Kai Huang (Intel) (SP1:32/0/17, SP2:16/2/22, SP3:20/0/20)
7. 11-17-0652-01-00ba-consideration-of-edca-for-wur-signal, Po-Kai Huang (Intel) (SP1:21/0/4, SP2:20/1/4, SP3:10/0/15, SP4:10/0/19)
8. 11-17/671r1 Considerations on WUR Synchronization, Steve Shellhammer (Qualcomm) (SP:23/0/17)
9. 11-17/387r1 Purpose Indication for WUR Packets, Xiaofei Wang (InterDigital) (SP: 18/3/29)
10. 11-17-0717-01-00ba-wur-retransmission-procedure, Hanseul Hong (Yonsei Univ.) (SP:3/0/30)
11. 11-17/659r1, On the Coexistence of 802.11ax and 802.11ba Signals, Xiaofei Wang (InterDigital) (SP1:11/0/21)
12. 11-17/695r3 WUR-Acknowledgement-Indication , Kaiying Lv (ZTE) (SP:?)
13. 11-17-0379-03-00ba-sfd-mac-proposal, Suhwook Kim (LGE)

**Motions:**

1. **Document 11-17/0668r1 Motion on Manchester Coding**

* Apply Manchester Coding in the WUR PHY Design
  + The structure of the OFDM symbol and the data rate is TBD
  + The Preamble design is TBD

**Mover:** Steve Shellhammer

**Second:** John Notor

**Y/N/A:** 37/0/0, Motion passes

1. **Document 11-17/0647r4**

**Move to add the followings into SFD:**

* A 20MHz non-HT preamble is prepended in any WUR PPDU, including L-STF, L-LTF and L-SIG fields.
* A 20MHz OFDM symbol, with tone spacing 312.5KHz and BPSK, and of duration 4us, is present immediately after the L-SIG field and right before the narrow band portion of any WUR PPDU.

**Mover:** Hongyuan Zhang

**Second:** Tianyu Wu

**Y/N/A:** 31/0/10, Motion passes

1. **Document 11-17/0716r3**

**Motion:** Move to add the following to the 802.11ba SFD:

* 802.11ba should reuse the conventional 802.11 power save procedures.
* 802.11ba shall not change existing 802.11 power save procedure.

**Mover:** Jinsoo Ahn

**Second:** Sung-Hyun Hwang

**Y/N/A:** 8/17/23, Motion fails

1. **Document 11-17/0654r3**

**Motion 1:** Move to add the following to the 802.11ba SFD:

* 11ba supports multiple data rates for the payload part of the wake-up packet

**Mover:** Eunsung Park

**Second:** Suhwook Kim

**Y/N/A: 35/2/7**, Motion passes

**Motion 2:** Move to add the following to the 802.11ba SFD:

* Manchester code shall be used for all of the data rates for the payload part of the wake-up packet

**Mover:** Eunsung Park

**Second:** Suhwook Kim

**Y/N/A: 32/0/9**, Motion passes

1. **Document 11-17/0655r1**

* **Motion: Move to change the 11ba SFD as follows**
  + R.3.3.B: For the transmission of wake-up packet using one sub-band, tThe OOK waveform of wake-up packet is generated by populating contiguous thirteen TBD number of 802.11 OFDM subcarriers with the subcarrier spacing of 312.5KHz
    - The WUR preamble part is TBD
    - The operation in DFS channel is TBD
    - Subcarrier indices are TBD
    - Coefficients are TBD

**Mover:** Eunsung Park

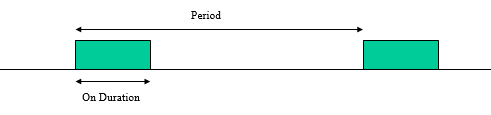
**Second:**

Motion postponed after rather lengthy discussion of the interpretation of the text. Minyoung proposes to have a discussion and bring it back after the break.

1. **Document 11-17/0651r1**

**Motion 1:** Move to add the following to 802.11ba SFD:

* The period of the WUR duty cycle as shown below is a multiple of a basic unit
* The basic unit is indicated by the AP



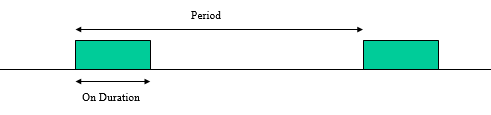
**Mover:** Po-Kai Huang

**Second:** Bin Tian

**Y/N/A: 27/3/7**, Motion passes

**Motion 2:** Move to add the following to 802.11ba SFD:

* The on duration in each period for WUR duty cycle as shown below is larger than or equal to a minimum wake-up duration
* The minimum wake-up duration is indicated by the AP



**Mover:** Po-Kai Huang

**Second:** Suhwook Kim

**Y/N/A: 28/1/9**, Motion passes

**Motion 3:** Move to add the following to 11ba SFD:

* + AP decides the starting point for one WUR duty cycle schedule
  + How to indicate the starting point is TBD

**Mover:** Po-Kai Huang

**Second:** Suhwook Kim

**Y/N/A: 26/0/9**, Motion passes

1. **Document 11-17/0652r1**

**Motion 1:** Move to add the following to 11ba SFD:

* + An AP reuses existing 4 ACs and corresponding EDCA parameters to transmit WUR signal
  + Note that WUR signal includes unicast wake-up packet, multicast wake-up packet, and WUR Beacon

**Mover:** Po-Kai Huang

**Second:** Shahrnaz Azizi

**Y/N/A:** 32/0/2, Motion passes

**Motion 2:** Move to add the following to 11ba SFD:

* + An AP may use any AC for sending a multicast wake-up packet
  + An AP may use any AC for sending a WUR Beacon

**Mover:** Po-Kai Huang

**Second:** Alfred Asterjadhi

**Y/N/A:** 33/0/4, Motion passes

**Motion 3:** Move to add the following to 11ba SFD:

* + An AP may use any AC for sending a unicast wake-up packet to a STA if the AP does not have pending buffered frame to the STA

**Mover:** Po-Kai Huang

**Second:** Zhou Lan

**Y/N/A:** 26/0/7, Motion passes

**Motion 4:** Move to add the following to 11ba SFD:

* + After an AP sends a WUR signal using EDCAF of a particular AC, the AP shall not update CW and retry count of the AC
  + After identifying failure for an unicast wake-up packet that is sent using EDCAF of a particular AC, AP shall not update CW and retry count of the AC

**Mover:** Po-Kai Huang

**Second:** Suhwook Kim

**Y/N/A:** 29/1/5, Motion passes

1. **Document 11-17/0671r2**

**Motion:** Move to add the following sentence to 802.11ba SFD:

“The WUR beacon frame may carry partial TSF for synchronization. The number of bits of the partial TSF is TBD.”

**Mover:** Steve Shellhammer

**Second:** Po-Kai Huang

**Y/N/A:** 41/0/4, Motion passes

1. **Document 11-17/0387r4**

**Motion:** Do you agree to add the following to the 802.11ba SFD

“A wake up packet should include a purpose field to indicate the purpose of the wake up operation.”

**Mover:** Xiaofei Wang

**Second:** James Lepp

**Minyoung declares the meeting to be in recess at 10.07 pm.**

**Thursday, May 11, 2017, 10:30-12:30 am**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-09-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* Motions
* TG documents review
* Presentations
* Recess

**Chair Minyoung Park (Intel) calls meeting to order at 10:30 am. (**About 90 persons in the room.)

Minyoung remindes about the attendance and goes through the agenda.

Minyoung makes a call for potentially essential patents. No response.

Minyoung asks if there are any questions on the agenda. No response.

**Motions, cont’d:**

**Motion:** Move to add the following to the 802.11ba SFD

“A wake up packet should include a purpose field to indicate the purpose of the wake up operation.”

**Mover:** Xiaofei Wang

**Second:** James Lepp

**Y/N/A: 30/16/8**, Motion fails

1. **Document 11-17/0717r1:**

**Motion withdrawn**

1. **Document 11-17/0659r3**

**Motion:** Move to insert the following to the 802.11ba SFD:

“802.11ba should enable the concurrent transmission of 11ax signal and wake up signal.”

**Mover:** Rui Yang

**Second:** Xiaofei Wang

**Y/N/A:** 7/15/29, Motion fails

1. **Document 11-17/0695r4**

**Motion:** Move to add the following to 11ba SFD:

An indication shall be carried in the wake-up packet to indicate whether a frame will be sent to trigger the acknowledgement.

**Mover:** Kaiying Lv

**Second:** Jianhan Liu

**Y/N/A:** 19/22/19, Motion fails

1. **Document 11-17/0379r4**

**Motion 1:**

Move to add followings to the 802.11ba SFD

* + Wake-Up mode signaling shall be defined for the WUR STA to enter the WUR mode
    - Explicit or implicit signaling is TBD
    - If signaling is explicit, Wake-Up mode signaling is done on the Primary connectivity radio
    - Wake-Up operating parameter may be notified in Wake-Up mode signaling
      * Detailed parameters are TBD

**Mover:** Suhwook Kim

**Second:**  Jinsoo Choi

**Y/N/A: 32/0/14**, Motion passes

**Motion 2**

**Motion:** Move to add followings to SFD

* + The channel where single wake-up signal is sent is located within the primary 20MHz channel of primary connectivity radio
    - The operation in DFS channel is TBD

**Mover:** Suhwook Kim

**Second:**  Jinsoo Choi

**Y/N/A:** 20/22/10, Motion fails

**Document 11-17/0655r1, which lead to a lengthy discussion has been updated to 11-17/0655r4, see motion under 5 above.**

**Motion: Move to change the 11ba SFD as follows**

R.3.3.B: For one method of the transmission of a wake-up packet using one sub-band, t~~T~~he OOK waveform of wake-up packet is generated by populating contiguous thirteen TBD number of 802.11 OFDM subcarriers (excluding DC if DC is part of thirteen subcarriers) with the subcarrier spacing of 312.5KHz

* The WUR preamble part is TBD
* The operation in DFS channel is TBD
* Subcarrier indices are TBD
* Coefficients are TBD (TBD coefficients are not equal to zero)

**Mover:** Eunsung Park

**Second:** Jinsoo Choi

Motion to amend the motion as follows

* **Move to change the 11ba SFD as follows**
  + R.3.3.B: For ~~one~~the method of the transmission of a wake-up packet using one sub-band, t~~T~~he OOK waveform of wake-up packet is generated by populating contiguous thirteen TBD number of 802.11 OFDM subcarriers (excluding DC if DC is part of thirteen subcarriers) with the subcarrier spacing of 312.5KHz
    - The WUR preamble part is TBD
    - The operation in DFS channel is TBD
    - Subcarrier indices are TBD
    - Coefficients are TBD (TBD coefficients are not equal to zero)

**Mover:** Adrian Stephens

**Second:** VK Jones

**Y/N/A:** 14/17/16 motion fails

**Result for the non-amended motion:**

**Y/N/A:** 25/11/24, motion fails

**TG documents review:**

Shahrnaz Azizi presents 11-17/0188r5, which is the latest revision of the Simulation Scenarios and Evaluation Methodology document. Since mainly small editorial changes are made compared to 11-17/0188r4, no motion is run to approve the latest version.

No motion to approve an updated version of WUR Usage Model Document, 11-17/0029.

**Presentations:**

**11-17/0642r2 “WUR MAC and Wakeup Frame”, Liwen Chu (Marvell):** The presentation discusses different fields that are needed in a wake-up frame, e.g. type, BSS color, and AID.

The proposal is

* Type 4 bits
* BSS color: 12 bits
* AID (optional) 11 bits
* Payload (optional)
* FCS

**Q:** You have broadcast for data and new management information, do you expect different procedure

**A:** All STAs need to receiver the latter, so this is why we separated it. However, if the group have other opinions, we are open for suggestions.

**Q:** You plan to reuse the AID from the baseline, but you did no reuse the format for the BSS Color.

**A:** We are open for suggestions also for AID.

**Q:** Do you see a reason why we need to increase the number of bits for the BSS color. I believe they simulated 6 bits was enough for 802.11ax

**A:** I don’t agree this was shown in 802.11ax.

**Q:** I agree with Liwen that 6 bits are actually not enough for Color bits.

**Minyoung declares the meeting to be in recess at 12.30 pm.**

**Thursday, May 11, 2017, 1:30-3:30 pm**

**Meeting Agenda:**

The ad-hoc meeting agenda is shown below, and published in the agenda document:

<https://mentor.ieee.org/802.11/dcn/17/11-17-0545-10-00ba-may-2017-tgba-agenda.ppt>

* Call meeting to order
* IEEE 802 and 802.11 IPR Policy and procedure
* TG timeline discussion
* Goal for July 2017 F2F meeting
* Teleconference call schedule
* Presentations
* Adjourn

**Chair Minyoung Park (Intel) calls meeting to order at 1.30 pm. (**About 30 persons in the room.)

Minyoung remindes about the attendance.

Minyoung makes a call for potentially essential patents. No response.

Minyoung goes through the agenda. No questions on the agenda.

Minyoung goes through the timeline shown below (page 37 in the agenda document):

* **2017**
  + **January**: TGba formation meeting
  + **November**: TGba Draft 0.1
* **2018**
  + **March**: TGba Draft 1.0
  + **September**: TGba Draft 2.0
* **2019:**
  + **March**: MDR (mandatory document review)
  + **July**: formation of sponsor ballot pool
  + **September**: Sponsor ballot
* **2020**
  + **July**: RevCom

Minyoung goes through the goals for the July meeting shown below (page 38 in the agenda document)

* **Review technical presentations**
  + Reach consensus on more details of PHY and MAC designs
  + Prioritize submissions: give higher priority to the basic operation of WUR (i.e. a single WUR packet transmission and reception)
* **Work on TGba task group documents**
  + Use case document (editor: RossYu)
  + Functional requirement document (editor: Ming Gan)
  + Evaluation methodology and simulation scenario document (editor: Shahrnaz Azizi)
  + Spec framework document (editor: Po-Kai Huang)
* **Review TG timeline**

Teleconference Call Schedule:

* June 05 (Monday), 10:00 ET
* June 19 (Monday), 17:00 ET
* June 26 (Monday), 23:00 ET

Motion to approve the teleconference call schedule

**Move:** Yunsong Yang

**Second:** John Notor

Motion passed by unanimous consent.

**Presentation:**

**11-17/0642r2 “WUR MAC and Wakeup Frame”, Liwen Chu (Marvell): Presentation continued from previous session.**

**Q:** I want to come back to the question why you propose 12 bits for BSS Color, when only 6 bits are used in 802.11ax.

**A:** In this Straw Poll I will not consider the exact the number of bits, that is left TBD. But even if there are only 6 bits in 802.11ax, it now seems this number may be too small.

**Q:** You propose to use BSS color as BSS identifier?

**A:** Yes.

**Q:** On slide 3, you propose to use two methods?

**A:** No, I describe two methods and wanted to obtain feedback on which ones of the methods the group prefers.

**Q:** You suggest 4 bits for the FCS, would be good with simulations

**A:** There are many papers discussing robustness as a function of the number of CRC bits.

**Straw Poll 1:**

* Do you support LP WUR frames at least include the following fields
  + Type
  + AP Identifier
  + FCS

**Y/N/A:** 12/0/6

**Straw Poll 2:**

* Do you support to have STA identifier in unicast WUR frame

**Y/N/A:** 11/3/7

**11-17/0641r1 “Wakeup frame length”, Liwen Chu (Marvell):** It is proposed that a specific frame type as a fixed length, but different frame types may have different length.

**Q:** I believe you are very restrictive on the number of bits to be used for packet length, but on the other hand generous when it comes to BSS color. Maybe this is too restrictive for the future. Fixed length may also mean that we have to use padding, which may be wasteful.

**Q:** Can you use the dummy symbol that is intended for spoofing.

**A:** No, this signal is for the main radio and modulated using BPSK, not OOK.

**Straw Poll 1:**

Do you support that WUR frames can have different length?

**Y/N/A:** 14/0/7

**11-17/0381r1 “WUR MAC issues follow-up”, Jeongki Kim (LGE):**

**Q:** The you want to accommodate the receives with poor performance, I think you should encourage good implementations. I also wonder if the difference in wake-up time is very different. Do you have a feeling for what the wakeup delay? Another alternative is just that the AP groups WUR based on time they need for wake up.

**Q:** On page 6, you broadcast the wake-up, but then only send data to a sub-set of these?

**A:** The wake-up can also be group address.

**Straw Poll 1:**

Do you support the following?

* A broadcast wake-up frame (B-WUF) includes the information to indicate the deadline on which WUR mode STAs should complete its wake up procedure after receiving the broadcast WUF

**Y/N/A:** 7/13/8

**11-17/0658r0 “Review of Multi-user wakeup schemes”, Yong Cheng (Huawei):**

The presentation goes through 6 different ways to achieve multi-user wakeup signaling.

Q: Which one do you prefer?

A: Option 3.

Q: How many groups do you consider?

A: I really don’t know.

Q: On slide 8, you mean 802.11 TIM?

A: Yes, everything is with the main radio.

Q: On slide 7, I am more concerned about how many STA is each group.

**Meeting is adjourned at 3.30 pm.**