IEEE P802.11
Wireless LANs

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| IEEE 802.11ba Task GroupMeeting Minutes for March 2017 Meeting,Vancouver, BC, Canada |
| Date: 03-16-2017 |
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Abstract

Meeting Minutes for the IEEE 802.11ba TG sessions held in Vancouver, BC, Canada, March 12-17, 2017.

**Monday, March 13, 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/17/11-17-0193-01-00ba-tgba-march-2017-meeting-agenda.ppt>

* + Call Ad-hoc meeting to order
	+ TGba introduction
	+ Call for submissions
	+ Set Ad-hoc meeting agenda
	+ IEEE 802 and 802.11 IPR Policy and procedure
	+ Participation in IEEE 802 Meetings
	+ Presentations
	+ Adjourn

**Chair Minyoung Park (Intel) calls meeting to order at 8.04 am. (**About 110 persons in the room.)

Minyoung goes through the agenda document 11-17/0193r1. Presentation of PHY 1-5 (as in the Agenda slide #12) are added to Monday AM1 (Ad-hoc) session. The revised agenda is approved unanimously.

The received submissions for this meeting are:

**Use case submissions:**

1. USE, 11-17/0372, "Additional usage models for WUR", Eduard Garcia-Villegas (UPC)
2. USE, 11-17-0406-00-00ba-use-cases-for-wur-in-its.pptx, James Lepp, BlackBerry

**PHY submissions:**

1. PHY, 11-17-0350-00-00ba-various-symbol-types-for-wur, Eunsung Park, LGE
2. PHY, 11-17-0351-00-00ba-effect-of-bandwidth-and-sampling-rate-on-performance, Eunsung Park, LGE
3. PHY, 11-17-0352-00-00ba- WUR Frame Structure Follow up, Dongguk Lim, LGE
4. PHY, 11-17-0357 A Narrow-Band Bipolar OOK Signal, Simon Qu, BlackBerry
5. PHY, 11-17-0365-00-00ba-Regulations-and-Noise-Figure-Impact-on-SNR , Steve Shellhammer, Qualcomm
6. PHY, 11-17-0366-00-00ba-WUR-Modulation-and-Coding , Steve Shellhammer, Qualcomm
7. PHY, “TX/RX architecture, operation channels and power consumption of 11ba devices”, Jianhan Liu, MediaTek
8. PHY, 11-17-0367-00-00ba-studies-of-PER-performance, Shahrnaz Azizi, Intel
9. PHY, 11-17-0368-00-00ba-motion-for-high-level-phy-design, Shahrnaz Azizi, Intel
10. PHY, 11-17-0326, WUR phase noise model follow-up, Minyoung Park, Intel
11. PHY, WUR link budget analysis, Rui Cao, Marvell
12. PHY, Waveform Generation for Waveform Coding, Junghoon Suh, Huawei
13. PHY, 11-17/0373, Performance Investigations on Single-carrier and Multiple-carrier-based WUR, Jia Jia, Huawei
14. PHY, 11-17-0377-00-00ba-False-Radar-Pulse-Detection-on-WUR-Signal, Allert van Zelst, Qualcomm
15. PHY, 11-17/0382r0, WUR Reference Signal, Woojin Ahn, WILUS
16. PHY, 11/17-0385 “Concurrent transmission of data and a wake-up signal in 802.11ax - Follow-up”, Leif Wilhelmsson, Ericsson
17. PHY, 11/17-0386 “Impact of reciprocal mixing on WUR performance” , Leif Wilhelmsson, Ericsson

**MAC submissions:**

1. MAC, 11-17-0342-00-00ba-wur-negotiation-and-acknowledgement-prodecure-follow-up, Po-Kai Huang, Intel
2. MAC, 11-17-0343-00-00ba-wur-beacon, Po-Kai Huang, Intel
3. MAC, 11-17-0354-00-00ba-initial-thoughts-on-MAC-procedures, Jason Guo, Huawei
4. MAC, 11-17-0364-00-00ba-Low-Latency-and-Low-Medium-Utilization, Steve Shellhammer, Qualcomm
5. MAC, “Assign and Update Wake-Up Signals in WLAN with Wake-Up Radio Receivers”, Jianhan Liu, MediaTek
6. MAC, 11-17-0371-00-00ba-WUR-duty-cycle-mode-and-timing-synchronization-follow-up, Tianyu Wu, MediaTek
7. MAC, 379r0: SFD MAC Proposal, Suhwook Kim (LGE)
8. MAC, 380r0: WUR MAC, 11-17/0402, WUR Wakeup Channel Access, Ronny Yongho Kim, KNUT
9. MAC, 11-17-0411-00-00ba-Consideration-of-WUR-Security, Kaiying Lv, ZTE Corp
10. MAC, straw polls deferred by teleconference, Liwen Chu
11. MAC, BSS management with WLS Wakeup frame, Liwen Chu, Marvell
12. MAC, Synchronization with Low Power Antenna, Liwen Chu, Marvell
13. MAC, Inter-BSS communication, Liwen Chu, Marvell
14. Channel switch, Suhwook Kim (LGE)
15. MAC, 11-17/0381, WUR MAC issues follow-up, Jeongki Kim, LGE
16. MAC, 11-17/387, Purpose Indication for WUR Packets, Xiaofei Wang, InterDigital

Minyoung reviews the Participants, Patents, and Duty to Inform slide, Patent Related Links and makes a call for potentially essential patents. No potentially essential patents reported and no questions asked.

**Presentations:**

**PHY, 11-17-0350-00-00ba-various-symbol-types-for-wur, Eunsung Park, LGE** The presentation is discussing 4 different symbols types suitable for OOK with data rates ranging from 125 kb/s to 500 kb/s. It is proposed that several different data rates should be supported in a similar way as several MCS are supported for data.

**Questions/Comments (Q):** Do you use a CP for each chip of the Manchester code?

**Answer (A):** Yes.

**Q:** You assumed perfect timing, do you also assume this structure for the preamble?

**A:** Synchronization is not discussed in this presentation.

**Q:** You already assume there is a SIG field indicating the symbol type used?

**A:** Yes you can do this in the SIG field.

**Q:** You indicate what symbol type is the preferred one through the main radio?

**A:** Yes.

**Q:** What is the advantage of your proposal, you reduce the packet length since the packet content is fixed? Is this the only advantage?

**A:** Yes, you can reduce the channel occupancy time.

**Q:** Why not just design for the worst case?

**A:** Too much overhead.

**Q:** It seems the performance is very similar based on the simulation results on page 21, so it seems we may not need more than one symbol type based on this.

**Q:** How did you do the detection?

**A:** In the time domain, by just comparing the received power with a threshold.

**Q:** The Manchester coding may also be seen as pulse position modulation. Just a comment.

**Straw poll:** Do you agree that 11ba support various symbol types?

**Y/N/A:** 19/7/46

**PHY, 11-17-0351-00-00ba-effect-of-bandwidth-and-sampling-rate-on-performance, Eunsung Park, LGE:** Various simulations results are presented when the bandwidth (number of used sub-carriers) as well as the used sampling rate are varied for generating the decision metric. The synchronization is not done correlating on the OOK symbol rate, but on the “sampling rate”, see example on page 13.

**Q:** The preamble you use, you use the first 3 symbols for synchronization?

**A:** Yes (see page 13 for more details).

**Q:** Why do we discuss sampling rate here etc,, since we need to have a legacy preamble running at 20 MHz anyway?

**A:** This only relates to the wake-up signal, coming after the legacy preamble.

**Q:** Why are we not considering a single-carrier transmitter?

**A:** It does not matter so much here, as the receiver it is treated as single carrier, i.e., no FFT processing etc.

**Q:** Reducing the sampling rate in the receive will save power. Do you think using the repetition scheme is suitable?

**A:** I see your point.

**Q:** The syncword you use, can that easily be mistaken for another ongoing transmission? That is, do you see a high probability for false alarm?

**A:** I did not consider this problem.

**Straw Poll:** Do you support to use a smaller bandwidth than 20 MHz in 11ba for the signal bandwidth

**Y/N/A:** 43/0/27

**PHY, 11-17-0352-00-00ba-WUR Frame Structure Follow up, Dongguk Lim, LGE:** This is a continued discussion of the proposed WUR preamble structure, which was initiated in the last f2f meeting.

**Q:** If you use the proposed threshold also for the preamble what is the probability of false detection?

**A:** This is not studied here.

**Q:** What do you mean by mode?

**A:** Unicast, multicast, or broadcast.

**Q:** Your assumption is that the legacy part is not part of the WUR PPDU, as it says that it follows the L-part?

**Q:** How many bits do you think you need in the control information field?

**A:** I don’t know.

**Q:** The whole wake-up frame can be very long considering that every bit is as least a few us. If we make this too long, it can be very inefficient and perhaps no one will use it. I envision that all that is done is to wake up the main receiver, the rest is signaled using the main transceiver.

**Q:** Maybe the legacy part is not robust enough to protect the wake-up signal, maybe more is needed.

**Q:** Do you want to have single format or multiple formats for protection?

**A:** Multiple formats.

**Q:** I don’t think it is interesting for a STA to know whether the wake-up packet is for one or more WURs, the only thing that is needed is that the WUR can detect the presence of a packet and can wake up the main transceiver. The more information you include, the more overhead you will introduce to the system.

**The ad-hoc meeting is adjourned at 10.00 am.**

**Tuesday, March 14, 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/17/11-17-0193-02-00ba-tgba-march-2017-meeting-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 January 2017 meeting
	+ Motion: January 2017 meeting minutes ([doc: IEEE 802.11-17/0185r0](https://mentor.ieee.org/802.11/dcn/17/11-17-0185-00-00ba-meeting-minutes-january-2017.docx))
	+ Vice-chair election process
	+ Presentations
	+ Recess

**Chair Minyoung Park (Intel) calls meeting to order at 8.00 am. (**About 50 persons in the room.)

Minyoung reminds about attendance.

Minyoung goes through the agenda document 11-17/0193r2.

The main agenda items for this week are:

* TG Vice-Chair election (Tuesday PM1)
* Review technical presentations
* 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: TBD)
* Review TG timeline

Minyoung asks if there are any other submissions or if there any comments on the order for the presentations. No comments.

**Motion to approve the agenda**

Move: John Notor

Second: Yunsong Yang

Motion passed by unanimous consent.

Minyoung goes through slide 21, call for potentially essential patents, and slides 22-26. No potentially essential patents reported and no questions asked.

Minyoug goes through the summery of the January meeting, slide 27.

**Motion to approve the minutes from the January meeting**

Move: John Notor

Second: Po-Kai Huang

Motion passed by unanimous consent.

**Presentations:**

**MAC, 11-17-0124-00-00ba-wur-mac-and-wakeup-frame, Liwen Chu, Marvell**: Strawpoll from teleconference presentation.

**Straw Poll 1:** Which in WUR Wakeup frame do you prefer to identify transmitter and receiver:

Option 1: Identifier of transmitter and receiver which are not MAC address,

Option 2: MAC Address

**Option 1/Option2/None of the options/Abstain:** 32/0/1/8

**Straw Poll 2:** Do you agree that in unicast frame transmission, PS-Poll or other trigger frame announces STA’s readiness after the STA receives Wakeup frame

**Y/N/A:** 16/1/34

**Straw Poll 3:** Do you agree that in group-addressed frame transmission, after the preparation period agreed by AP and STAs, AP can transmit broadcast/multicast frames?

**Y/N/A:** 19/0/31

**MAC, 11-17-0342-00-00ba-wur-negotiation-and-acknowledgement-prodecure-follow-up, Po-Kai Huang, Intel**: This presentation is a follow-up of the presentation at one of the teleconferences. The presentation covers:

* + WUR negotiation procedure
	+ Wake-up packet acknowledgement procedure

For the WUR negotiation procedure it is proposed to

* + Define WUR Action frame
	+ Define WUR Mode Element to carry WUR information

For the WUR acknowledgement procedure of unicast wake-up packet, it is proposed to

* + Define timeout interval to identify wake-up packet transmission success/failure
	+ Enable successive wake-up packet transmission to increase reliability

**Q:** Is the negotiation packet sent using OOK?

**A:** No.

**Q:** The time it takes to wake up the main radio, is that negotiated every time you wake up?

**A:** No, not unless you want to update it.

**Q:** Seems like the wake-up time should be negotiated during association. Do you believe the STA is providing a specific value or do you see it more as a classification?

**A:** More like a classification, but details are to be decided on later. Personally I think a STA should report its capability rather than specifying certain requirements from the specification.

**Q:** I believe this is similar to TWT in a way.

**Q:** I believe we should separate between capability and parameters that may be set.

**Q:** I believe it is problem that this information is not encrypted.

**A:** This is done in the main radio, so whatever security is supported there can be used.

**Straw Poll 1:** Do you support the following:

* + Define WUR Action frame to enable WUR negotiation

**Y/N/A:** 27/0/17

**Straw Poll 2:** Do you support the following:

* STA’s Duty cycle of wake-up receiver (WURx)

**Y/N/A:** 24/3/21

**Straw Poll 3:** Do you support the following:

* + Define WUR Mode element that can carry following WUR information
		- STA’s Duty cycle of wake-up receiver (WURx)

**Y/N/A:** 9/3/31

**Straw Poll 4:** Do you support the following acknowledgment procedure for unicast wake-up packet

* + After AP sends a wake-up packet to a STA, AP waits for a timeout interval
		- If AP receives any transmission from the STA within the timeout interval, then the wake-up packet transmission is successful
		- Otherwise, the wake-up packet transmission fails, and AP may retransmit the wake-up packet to the STA

**Y/N/A:** 22/1/21

**Straw Poll 5:** Do you support the following for multiple unicast wake-up packet transmissions?

* + If a wake-up packet is transmitted to the same intended STA within the existing timeout interval of the previous wake-up packet transmission, then a new timeout interval is established to replace the existing timeout interval

**Straw Poll Deferred**

**MAC, 11-17-0343-00-00ba-wur-beacon, Po-Kai Huang, Intel:** The presentation proposes to define a WUR Beacon

* + For maintaining connectivity between STA and AP
	+ To carry timing information for synchronization purpose
	+ To carry other TBD information
	+ To be differentiated from wake up packet
	+ With consideration of controlling overhead
	+ The WUR Beacon interval should be configurable

**Q:** I agree that the alternative solution is not as good. For the WUR beacon, why do we need this TSF information?

**A:** I use this as this is how it is done today if we want to reuse the procedure used today.

**Q:** This is a new radio, so maybe we don’t need to do things in the same way as today.

**Q:** I think this may be useful for sensor networks, but I think there are also use cases where this is not needed.

**Q:** This is important, but I think we need to discuss more before deciding on details like intervals.

**A:** The beacon interval is configurable, so it is quite flexible

**Q:** Do you think it is reasonable to miss as many as 16 consecutive WUR beacons?

**Q:** Do you think every WUR beacon should have this time information?

**A:** Right now the question in the Straw Poll is whether it can contain time information.

**Straw Poll** 1: Do you support the following?

* + Define WUR Beacon

**Y/N/A:** 29/2/16

**Straw Poll 2:** Do you support the following?

* + WUR Beacon interval can be indicated in WUR Mode element

**Y/N/A:** 21/0/19

**Minyoung declares the group to be in recess at 9.57 am.**

**Tuesday, March 14, 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/17/11-17-0193-03-00ba-tgba-march-2017-meeting-agenda.ppt>

* + Call meeting to order
	+ IEEE 802 and 802.11 IPR Policy and procedure
	+ Vice-chair election
	+ Presentations
	+ Recess

**Chair Minyoung Park (Intel) calls meeting to order at 1.36 pm. (**About 95 persons in the room.)

Minyoung remindes about the attendance.

Minyoung goes through the agenda and updates the agenda based on a suggestion from one of the presenters.

Minyoung asks if there is any more nominees for the Vice-Chair positions. No more nominee announced.

**Election of Vice-Chair for 802.11ba**

**Nominees**: 1st VC: Younsong Yang (Huawei) **Y/N/A:** 62/0/1

2nd VC: Eunsong Park (LGE): **Y/N/A:** 60/0/1

**Presentations:**

**PHY, 11-17-0357 A Narrow-Band Bipolar OOK Signal, Simon Qu, BlackBerry:** The presentation is concerned with generating OOK which is more narrowband. The proposal is to use a bipolar signal, where essentially the ON signal may can be generated either +1 or -1 instead of just using +1. For an envelope detector, this makes no difference, but it results in a narrower transmit spectrum.

**Question/Comment (Q):** I think it is a nice idea, but I see that we maybe are not limiting ourselves for OOK.

**Q:** In some cases you are limited by the regulatory requirements on psd, and then there may actually be an advantage to be more wideband.

**PHY, 11-17-0365-00-00ba-Regulations-and-Noise-Figure-Impact-on-SNR , Steve Shellhammer, Qualcomm:** The presentation compares how the regulatory restrictions make a difference concerning what output power can be used. This together with an expected higher noise figure (NF) is used to determine how much better sensitivity is needed to obtain the same range as the main transceiver. The NF for the WUR is expected to be 8 dB worse than the NF for the main receiver based on input from Qualcomm’s RFIC designers.

The results are that the requirement on SNR is 12dB and 15dB harder than for the main receiver, for the 2.4 GHz and 5 GHz band, respectively.

**Q:** The 8dB worse NF I expect is due to the lower power implementation? But you did not take the bandwidth into account?

**A:** The NF does not depend on the bandwidth.

**Q:** Based on these requirements, why not go for a higher bandwidth?

**A:** The are reasons also against large bandwidth, but these is not cast in stone.

**Q:** In practice the output power may be limited by the out-of-band emission, i.e., what leaks into adjacent bands.

**A:** We looked this also from practical point of view, but it is not as much of problem as you indicate. We have products at 30 dBm in US. In Europe 20 dBm is very easy to achieve also for the channels closest to the band edges.

**Q:** The noise figure you use is for an implementation, but the spec is much more relaxed.

**A:** This is why we would like vendors to provide their delta to the main receiver, but they do not need to reveal the actual NF.

**PHY, 11-17-0366-00-00ba-WUR-Modulation-and-Coding , Steve Shellhammer, Qualcomm:**

The presentation compares repetition coding and Manchester coding based on simulations. One advantage with Manchester coding is that the threshold does not need to be estimated. A gain of 1-2 dB is found by means of simulation.

**Q:** If you anyways need a ADC I don’t think we need to be restricted to OOK

**A:** One reason for OOK is the frequency generation.

**Q:** How do you get to 250kb/s?

**A:** The symbol period is 4us with the 64 point FFT and a CP of 0.8us. This was the original idea of how to generate the signal.

**Q:** We have simulated similar things. What is the reason why Manchester coding is better?

**A:** The optimum threshold is hard to find and using a sub-optimum is probably the reason for the loss.

**Q:** Does not the PAPR have an impact. You are using an OFDM signal to generate the OOK signal.

**A:** It is not really an issue for regulations, but more for the design of the PA.

**Q:** Since you are assuming OFDM, do you suggest sending more than one signal?

**A:** Not in this work.

**Straw Poll:** Do you support using Manchester Coding in the WUR PHY Design?

* + The structure of the OFDM symbol and the data rate is TBD
	+ The Preamble design is TBD

**Y/N/A:** 31/10/22

**PHY, 11-17/0432 “RX architecture, operation channels and power consumption of 11ba devices”, Jianhan Liu, MediaTek:**

**Q:** I don’t think it will work with open loop

**A:** It is not exactly open loop, sometimes it is calibrated as indicated in the figure.

**Q:** Are the power consumption for the active mode?

**A:** Yes.

**Q:** Is the LNA included in the power consumption estimation?

**A:** No.

**Q:** This power consumption does just barely meet the PAR

**A:** Yes.

**Q:** The reason why you don’t meet the PAR is because you have very power hungry frequency generation. And without this frequency generation many of your suggestions will be hard to achieve.

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

**Wednesday, March 15, 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/17/11-17-0193-04-00ba-tgba-march-2017-meeting-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 65 persons in the room.)

Minyoung remindes about the attendance.

Minyoung goes through the agenda and asks if there are any more contributions. No more contributions announced.

Minyoung reviews the Participants, Patents, and Duty to Inform slide, Patent Related Links, Call for Potentially Essential Patents, and makes a call for potentially essential patents. No potentially essential patents reported and no questions asked.

**Presentations:**

**MAC, 11-17-0371-00-00ba-WUR-duty-cycle-mode-and-timing-synchronization-follow-up, Tianyu Wu, MediaTek:** The presentation is a follow-up from a conference call and is concerned with how to deal with time-drift when duty-cycled WURs are used.

**Q:** The common sync signal, is that the same as the WUR beacon we have discussed in another presentation?

**A:** In principle, but maybe this carry less information and is just used for synchronization. It may also be less reliable since it is OK to miss some.

**Q:** Do you have any idea about the periodicity of the sync signal?

**A:** Much slower than the normal beacon, say on the order of seconds.

**Q:** Because of CSMA, you cannot really guarantee that the sync signal is sent exactly when intended. Any thought on that?

**A:** The reception window should be set long enough, but more studies are needed.

**Q:** You are adding complexity, maybe the power saving is not that great after all?

**A:** The power saving is significant. This was discussed in an earlier presentation and in presentations by Intel in the past as well.

**Straw Poll 2:** Do you agree that 802.11ba shall provide a synchronization mechanism to solve the timing mismatch problem in WUR duty cycle mode?

**Y/N/A:** 21/0/22

**MAC, 11-17-0354-00-00ba-initial-thoughts-on-MAC-procedures, Jason Guo, Huawei:**

**Straw Poll 1:** Do you agree that the STA should send a response frame to the AP using primary connectivity radio after receiving a wakeup packet?

**Y/N/A:** 21/0/20

**Straw Poll 2:** Do you agree that a STA shall not transmit WUR signal if the primary connectivity radio of the STA is turned off?

**Y/N/A:** 12/1/21

**Straw Poll 3:** Do you agree that the AP can send a Trigger Frame in 11ax to solicit response frames from one or more STAs after sending a wakeup packet to the STA(s)?

**Y/N/A:** 11/1/22

**Straw Poll 4:** Do you agree to define a WUR Beacon frame which can be transmitted periodically?

* + The WUR Beacon is transmitted to WURs

**Y/N/A:** 17/0/19

**Straw Poll 5:** Do you agree to use EDCA to send wakeup packets?

* + The EDCA parameter set for wakeup packets is TBD

**Y/N/A:** 17/1/18

**MAC, 11-17-0364-00-00ba-Low-Latency-and-Low-Medium-Utilization, Steve Shellhammer, Qualcomm:** The proposal to achieve both low latency and low medium utilization is that the WUR should listen frequently at the STA and AP should transmit the WUR infrequently.

**Q:** I believe this approach makes sense. Any thought of the intervals?

**A:** We need a common WUR beacon interval, but then different STA can use different intervals. Basically, we need to design something that can support STAs with different requirements.

**Q:** Do you assume that the wake-up packet must come when the WUR is woken up?

**A:** Yes.

**Q:** Does the beacon include any other information than for synchronization.

**A:** In this case a packet is either for sync or for wake-up.

**USE, 11-17/0372, "Additional usage models for WUR", Eduard Garcia-Villegas (UPC):**

In addition to the seven usage models discussed up until now, the following additional usage models are proposed:

* Usage Model 8: Put to sleep packet
* Usage Model 9: Wake-Up AP
* Usage Model 10: Wake-Up (or Sleep) Packet Forwarding
* Usage Model 11: out of band signaling
* Usage Model 12: beyond IEEE 802.11

**Q:** With regard to e.g. sleep packet, do you have any figures showing the gain compared to using the main radio?

**A:** We have some results that I can share.

**Q:** With respect to Model 12, I believe we initially agreed on not supporting this to limit the scope of the work. I would propose to put hooks in for this, but maybe not really work on it.

**A:** I agree.

**Q:** For usage model 10, are you proposing that we should develop some mesh protocol?

**A:** No, this was just to discuss where a WUR may be useful.

**Straw Poll 1:** Would you add usage model 8 of this document to TGba’s Usage Model Document in its current form?

**Y/N/A:** 1/8/35

**Straw Poll 2:** Would you add usage model 9 of this document to TGba’s Usage Model Document in its current form?

**Y/N/A:** 15/1/21

**Straw Poll 3:** Would you add usage model 10 of this document to TGba’s Usage Model Document in its current form?

**Y/N/A:** 0/7/30

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

**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/17/11-17-0193-05-00ba-tgba-march-2017-meeting-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 100 persons in the room.)

Minyoung remindes about the attendance and goes through the agenda.

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

**Presentations:**

**USE, 11-17-0406-00-00ba-use-cases-for-wur-in-its.pptx, James Lepp, BlackBerry:** The presentation proposes to add two usage models related to Intelligent Transportation Systems (ITS).

* **Usage Model 1:** Wake Up Vehicle-to-Pedestrian (V2P) Radio
* **Usage Model 2:** WUR Vehicle-to-Pedestrian (V2P)

**Q:** How do you limit to only those that are supposed to receive these wake-up packets and no others.

**A:** Good point. Maybe inactivate WUR if not located close to a potentially dangerous location, like an intersection. Maybe it is possible to use beamforming to only address intentional receivers.

**Q:** Is the wake-up signal sent in-band?

**A:** It can be sent either in-band or out-of-band.

**Q:** Have you estimated the size of the payload of the wake-up packets?

**A:** Not really, but I can try to provide some information regarding this.

**Q:** I just want to add that this is very interesting also when there is very little traffic. There are roads with little traffic, but still there is a relatively high risk for accidents for various reasons.

**Q:** I am supportive to this usage model. It would be good with some power saving analysis. I believe you probably can save a lot.

**Straw Poll:** Should the 802.11ba task group add the above usage models to WUR?

**Y/N/A:** 34/0/26.

**PHY, 11-17-0377-00-00ba-False-Radar-Pulse-Detection-on-WUR-Signal, Allert van Zelst, Qualcomm:** The OOK may falsely trigger a radar detect if used in a frequency band where radars must be detected. The presentation also high-lights potential solutions:

* + Limit the operation of WUR to non-DFS channel
		- 2.4 GHz band has better range
		- Client with WUR receiver is also relieved from the burden of potential frequent channel switching due to DFS master’s radar detection outcome

**Q:** For how long do you look in your algorithm to declare radar being present.

**A:** You need to listen all the time.

**Q:** For which category of radar does this cause a problem?

**A:** There is a large span of pulse length for radars, and the 4us pulse length falls within this range.

**PHY, 11-17-0367-00-00ba-studies-of-PER-performance, Shahrnaz Azizi, Intel:**

**Q:** You say OOK is not sensitive to the delay spread, you should maybe consider UMi channel?

**A:** I believe it depends what operating point you consider.

**Q:** What do you mean with I&Q or only I?

**A:** Basically that you either use two receiver chains (I and Q) or one (just I).

**Q:** Does the SNR include noise figure?

**A:** SNR does not include the noise figure. The noise figure you add in the link budget calculation.

**Q:** It would be good to add a delay in the channel to generate a phase shift.

**A:** a random phase was added

**Q:** What was the bandwidth for the SNR calculation?

**A:** 4 MHz.

**Q:** It seems we need to enhance the performance. Do you have any idea of how it can be improved?

**A:** Not really clear how much we need to improve the performance at this point I believe.

**PHY, 11-17/0373, Performance Investigations on Single-carrier and Multiple-carrier-based WUR, Jia Jia, Huawei:**

**Q:** This comparison is highly dependent on the receiver design.

**Q:** I don’t believe this is any difference in terms of performance as indicated in your simulations.

**Q:** I believe there is some issues with the normalization and that is why you obtain such large difference in the performance.

**Straw Poll:** Do you agree to generate the wake-up packet OOK waveform by populating TBD number of tones?

* + The WUR preamble part is TBD

**Y/N/A:** 30/8/29

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

**Thursday, March 16, 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/17/11-17-0193-06-00ba-tgba-march-2017-meeting-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 10.33 am. (**About 90 persons in the room.)

Minyoung remindes about the attendance.

Minyoung goes through the agenda and asks if there are any comments. No comments.

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

**Motions:**

1. **Document 11-17/0368r1**

**Motion 1:** Move to approve the use of OOK for modulation of the payload portion of the wake-up packet. The Preamble design is TBD. The operation in DFS channels is TBD.

**Mover:** Shahrnaz Azizi

**Second:** Po-Kai Huang

**Y/N/A:** 40/0/16, Motion passes

1. **Document 11-17/0354r2**

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

A STA should send a response frame to the AP using primary connectivity radio after receiving a unicast wakeup packet.

**Mover:** Jason Yuchen Guo

**Second:** Ross Jian Yu

**Y/N/A:** 46/0/16, Motion passes

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

A STA shall not transmit WUR signal if the primary connectivity radio of the STA is turned off.

**Move:** Jason Yuchen Guo

**Second:** Po-Kai Huang

**Y/N/A:** 22/3/26, Motion passes

Note: In Motion 2 turned off means cannot transmit or receive, i.e., powered off.

**Motion 3:** Move to add the following to the 802.11ba SFD:

The AP can send a Trigger Frame in 11ax to solicit response frames from one or more STAs after sending a wakeup packet to the STA(s).

**Mover:** Jason Yuchen Guo

**Second:** Po-Kai Huang

**Y/N/A:** 22/0/35, Motion passes

**Motion 4:** Move to add the following to the 802.11ba SFD:

Define a WUR Beacon frame which can be transmitted periodically

* + - The WUR Beacon is transmitted to WURs.

**Mover:** Jason Yuchen Guo

**Second:** Po-Kai Huang

**Y/N/A:** 36/0/12, Motion passes

**Motion 5:** Move to add the following to the 802.11ba SFD:

Use EDCA to send wakeup packets

* + - The EDCA parameter set for wakeup packets is TBD

**Mover:** Jason Yuchen Guo

**Second:** Po-Kai Huang

**Y/N/A:** 39/0/12, Motion passes

1. **Document 11-17/0342r4**
* **Motion 1:** Move to add the following to the 802.11ba SFD:’
	+ Define WUR Action frame to enable WUR negotiation
	+ Note that WUR Action frame is sent through primary connectivity radio

**Mover:** Po-Kai Huang

**Second:** Jianhan Liu

**Y/N/A:** 24/3/18, Motion passes

* **Motion 2:** Move to add the following to the 802.11ba SFD:’
	+ STA can have Duty cycle mode for wake-up receiver (WURx)

**Mover:** Po-Kai Huang

**Second:** Tianyu Wu

**Y/N/A:** 23/2/18, Motion passes

* **Motion 3:** Move to add the following to the 802.11ba SFD:’
	+ After AP sends a unicast wake-up packet to a STA, AP waits for a timeout interval
		- If AP receives any transmission from the STA within the timeout interval, then the wake-up packet transmission is successful
		- Otherwise, the wake-up packet transmission fails, and AP may retransmit the wake-up packet to the STA

**Mover:** Po-Kai Huang

**Second:** Jason Guo

**Y/N/A:** 34/0/3, Motion passes

1. **Document 11-17/0343r3**
* **Motion 2:** Move to add the following to the 802.11ba SFD:’
	+ WUR Beacon interval can be indicated in WUR Mode element
	+ Note that WUR mode element is sent through primary connectivity radio

**Mover:** Po-Kai Huang

**Second:** Jason Guo

**Y/N/A:** 13/0/22, Motion passes

1. **Document 11-17/0373r2**
* **Motion:** Move to add the following to the 802.11ba SFD:’
	+ The OOK waveform of wake-up packet is generated by populating TBD number of 802.11 OFDM subcarriers
		- The WUR preamble part is TBD
		- The operation in DFS channel is TBD

**Mover:** Ming Gan

**Second:** Peter Loc

**Y/N/A:** 25/0/12, Motion passes

1. **Document 11-17/0124r4**
* **Motion 1:** Move to add the following text to the 802.11ba SFD:’
	+ The identifier of transmitter and/or receiver in a wakeup frame shall not be the MAC address.

**Mover:** Liwen Chu

**Second:** Po-Kai Huang

**Y/N/A:** 22/7/19, Motion passes

* **Motion 3:** Move to add the following text to the 802.11ba SFD:’
	+ After the transmission of broadcast wakeup frame, the AP can transmit broadcast/multicast frames through primary connectivity radio after the preparation period.

**Mover:** Liwen Chu

**Second:** Jianhan Liu

**Y/N/A:** 19/1/18, Motion passes

1. **Document 11-17/0027r4**
* **Motion:** Move to add to the 11ba SFD:
	+ IEEE 802.11ba shall provide mechanisms to enable re-discovery of WUR stations by AP.

**Mover:** Jianhan Liu

**Second:** Tianyu Wu

**Y/N/A:** 15/4//5, Motion passes

Note: The actual voting for this motion took place during pm1 as the am2 session ended before the voting could be done.

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

**Thursday, March 16, 2017, 10:30-12:30 am**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0193-06-00ba-tgba-march-2017-meeting-agenda.ppt>

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

**Chair Minyoung Park (Intel) calls meeting to order at 13.33 am. (**About 40 persons in the room.)

Minyoung goes through the agenda, including the goals for the May meeting.

**Proposed teleconference schedule (2 hours)**

* + - April 03 (Monday), 10:00 ET
		- April 17 (Monday), 17:00 ET
		- May 01 (Monday), 23:00 ET

**Teleconference schedule agreed**

**TGba Documents Review**

**Motion:** Move to accept 11-17/0039r2 as the 802.11 TGba draft Functional Requirements Document

**Mover:** Ming Gan

**Second:** Yunsong Yang

**Y/N/A:** 22/0/4, Motion passes

**Motion:** Move to accept 11-17/0188r4 as the IEEE 802.11 TGba draft Simulation Scenarios and Evaluation Methodology Document

**Mover:** Shahrnaz Azizi

**Second:** Yunsong Yang

**Y/N/A:** 18/0/3, Motion passes

1. **Document 11-17/0371r4**

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

* + Define a synchronization mechanism to solve the timing mismatch problems associated with WUR duty cycle mode.

**Mover:** Tianyu Wu

**Second:** Peter Loc

**Y/N/A:** 22/0/4, Motion passes

1. **Document 11-17/0406r4**

**Motion:** Move to add Usage Models (slide #5 and slide #7) from this presentation (11-17/0406r4) to the 802.11ba task group Usage Models document (11-17/0029r4).

**Mover:** James Lepp

**Second:** Ross Yu

**Y/N/A:** 13/0/9, Motion passes

1. **Document 11-17/0054r3**

Note: In Motion 1 all WUR mode STAs refers to STAs associated to the AP, not to STAs within range.

**Motion 1:** Move to add to SFD:

* + 802.11ba spec shall define a mechanism to wake up all WUR mode STAs (i.e., broadcast wake-up frame)

**Mover:** Jeongki Kim

**Second:** Jinsoo Choi

**Y/N/A:** 11/5/11, Motion fails

**Motion 2:** Move to adopt the following to SFD:

* + 802.11ba spec shall define a mechanism to wake up multiple WUR mode STAs (e.g., multi-user wake-up frame)

**Mover:** Jeongki Kim

**Second:** Jinsoo Choi

**Y/N/A:** 22/1/6, Motion passes

1. **Document 11-17/0372r3**

**Motion:** Move to add Usage Model 9 (slide #6) from this presentation (11-17/0372r3) to TGba’s Usage Models Document (11-17/0029r4)

**Move: Ross Yu**

**Second: Xiaofei Wang**

**Y/N/A:** 14/4/5, Motion passes

**Meeting is adjourned at 3.30 pm.**