IEEE P802.11
Wireless LANs

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| IEEE 802.11ba Task GroupMeeting Minutes for July 2017 Meeting,Berlin, Germany |
| Date: 07-14-2017 |
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Abstract

Meeting Minutes for the IEEE 802.11ba TG sessions held in Berlin, Germany, July 9-14, 2017.

**Monday, July 10, 2017, 8:00-10:00 am**

**Ad-hoc Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-03-00ba-july-2017-tgba-agenda.pptx>

* + 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
		- MAC architecture implications of TGba (clause 5.1, et al) – Mark Hamilton (30 min)
		- From the list of submissions
	+ Adjourn

**Chair Minyoung Park (Intel) calls meeting to order at 8.00 am. (**About 100 persons in the room.)

Minyoung goes through the agenda document 11-17/0883r3. 802.11ba has been allocated nine time-slots and there are about 40 submissions.

The main topics for this week are:

* **Review and approve TGba Spec Framework Document (SFD)**
* **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**

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 in a similar way as was done in the May f2f meeting. The received presentations, and the proposed order of presentation, after some minor change, are shown below.

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**PHY presentations**:

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

1. 11- 17/969r0 Analysis on the Impact of Blank GI to ISI, Junghoon Suh (Huawei)

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

1. 11-17-0964-00-00ba-signal-bandwidth-and-sequence-for-ook-signal-generation, Eunsung Park (LGE)
2. 11/17-1017r0 “Variable signal bandwidth of the wake-up signal for enhanced WUR performance”, Leif Wilhelmsson (Ericsson)
3. 11/17-1018r0 “Some Results on Synchronization Performance”, Dennis Sundman (Ericsson)
4. 17/1013 Considerations on WUP bandwidth and CCA, Jinsoo Ahn (Yonsei Univ.)
5. 11-17/1037 Performance Evaluation of OOK Waveform Coding Schemes with Impairments, Rui Yang (InterDigital)

**(C) Data rates and coding**

1. 11-17-0965-00-00ba-data-rate-for-range-requirement-in-11ba, Eunsung Park (LGE)
2. 11-17/0966r0 Data Rate Selection for Wake-Up Receiver, Kaiying Lv (ZTE)
3. 802.11-17/990   WUR Data Rates (Steve Shellhammer and Bin Tian, Qualcomm)

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

1. 11-17/0967r0 Consideration of WUR packet design, Kaiying Lv (ZTE)
2. 11-17-0997-00-00ba-preamble-options, Shahrnaz Azizi (Intel)
3. 11-17-0983-00-00ba WUR preamble SYNC field design, Rui Cao (Marvell)
4. 802.11-17/991   Preamble Design and Simulations (Steve Shellhammer and Bin Tian, Qualcomm)
5. 11/17-1020r0 wur preamble design follow-up, Tianyu Wu (MediaTek)
6. 11-17/ 963r0 Signaling method for multiple data rates, Dongguk Lim (LGE)

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

**MAC presentations**:

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

1. 11-17-0953-00-00ba-WUR-Mode-Discussion, Suhwook Kim (LGE)
2. 11-17-0954-00-00ba-WUR-Mode-Signaling, Suhwook Kim (LGE)
3. 11-17/0968r0 Further Consideration of WUR Acknowledgement Indication , Kaiying Lv (ZTE)
4. 11-17-0972 Definition of WUR Mode, Po-Kai Huang (Intel)
5. 11ba power save, Liwen Chu (Marvell)
6. 11-17/984r0 - WUR Mode Transition Mechanism, Yongho Seok (MediaTek)
7. 802.11-17/992  Power save mode for WUR (Jason Yuchen Guo, Huawei)
8. 17/978, Power saving in duty cycle mode, Jeongki Kim (LGE)
9. 11-17-1000-00, WUR coexistence with existing power save mode, Woojin Ahn (WILUS)
10. 17/1012 WUR with conventional 802.11 power save follow up, Jinsoo Ahn (Yonsei Univ.)
11. 17/1015r0 Status mismatch problem in WUR transmission procedure, Hanseul Hong(Yonsei Univ.)
12. 11-17-1051-00-00ba , Uplink transmission behavior of WUR STA, Woojin Ahn (WILUS)
13. 11-17/1065 Power Consumption Evaluation for a few WUR MAC Procedures, Xiaofei Wang (InterDigital)

**(B) Basic WUR Beacon operation**

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

1. 11ba wakeup frame format, Liwen Chu (Marvell)
2. 17/977, Address structure in unicast wake-up frame, Jeongki Kim (LGE)
3. Considerations on the WUR frame format, Alfred (Qualcomm)
4. 11-17-1008 Vendor Specific WUR frame, Po-Kai Huang (Intel)

**(D) Multicast wake-up packet transmit/receive operation**

1. SP: 17/381, WUR MAC issues follow-up (for Straw Polls), Jeongki Kim, (LGE) – Only SP1 (5 SPs deferred)
2. SP: 11-17-0630-00-00ba-SFD-Proposal-on-Retransmission, Suhwook Kim (LGE)

**(E) Security**

1. 11-17/0660, WUR Security Proposal, Yunbo Han, Huawei
2. 11-17/0411r0 consideration of WUR security, Kaiying Lv (ZTE)
3. 11-17/0660, WUR Security Proposal (SP only), Yunbo Han/Yunsong Yang

**(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. 11-17/440, Inter-BSS Communication, Liwen Chu (Marvell)
4. 11-17/728, AP Power Saving, Xiaofei Wang (InterDigital)
* **Usage Model**
1. 11-17-0982-00-00ba, More on Wake-up AP usage model, Eduard Garcia-Villegas (UPC)

Minyoung asks is there are any questions on the agenda. No questions asked and the agenda is approved.

**Presentations:**

**11-17/1025r0 “802.11ba Architecture Discussion” Mark Hamilton (Ruckus/Brocade):**

Since 802.11ba may have an impact on the architecture, Mark Hamilton wanted to inform the TG about architecture concepts within 802.11. The purpose is to inform TGba members, and not to provide solutions. The purpose of attending the session and making the presentation is also to learn what the current view is within the 802.11ba TG and inform the ARC SC members if there are any new architectural concepts. Mark had prepared a number of questions for the TG. Not all were addressed during the session.

Questions for TGba:

1. Is the WUR an independent PHY?

**Answer (A):** It is a completely new modulation format, so in that sense it is an independent PHY. Still it is not completely good to call in independent as it is clearly stated in the PAR that it is a companion radio, which indicates it is not independent.

1. Is the WUR an independent MAC?

**A:** The idea is to try to reuse the main MAC ideas, but there is a separate MAC. The question is really if it will be standardized or if it is left for implementation.

1. Is the WUR always physically collocated with an 802.11 AP or STA?

**A:** Yes.

1. Does the WUR have an address? Or, does it “share” the collocated STAs address?

**A:** We will not use the MAC address. And there is no reason for the WUR to have its own MAC address. An optimized address is expected to minimized the overhead.

1. Does the WUR MAC connect to/integrate with the 802.11 MAC?
2. OR… Does the WUR ‘wake’ the device, and the device contains independent WUR and an 802.11 MAC/PHY, and some ‘host function’ between them?
3. Perhaps related/duplicate: Does the introduction of the WUR impact the behavior of a collocated/integrated STA’s MAC/PHY?

Mark also encouraged the TG to think about the following more advanced questions. Some were partly addressed as shown below.

1. Does a WUR associate to a BSS?

**A:** By itself it will not associate to a BSS.

1. If yes, the same BSS as any collocated/integrated STA, or a separate ‘overlay’ BSS of WUR devices?
2. Does the WUR work with all 802.11 PHYs e.g. a, b, g, n, ac, ad, ah, ax, ay?

**A:** It may be too early to answer now. The main radio and the WUR may be using different bands.

1. Does the WUR work with mesh STAs? IBSS? OCB?

**A:** Still under discussion whether a STA can wake up a AP.

**11-17/0969r0 “Analysis on the Impact of Blank GI to ISI” (Junghoon Suh, Huawei):** The presentation is concerned with different forms of wave form coding (WFC) in order to mitigate the impact of ISI.

In particular, it is suggested to send a blank GI to ensure that no ISI occurs. Exactly what causes the ISI problem, i.e., whether it is the channel or the receiver filter was somewhat unclear for the audience.

**Question/Comment (Q):** I find it somewhat strange that it seems to be an error floor in case of an AWGN channel which is due to ISI, whereas no such floor exists for channel model D.

**Answer (A):** Another filter is used for the AWGN channel and this is what causes the ISI.

**Q:** I don’t think there is a problem as you describe it, I believe you don’t have the right timing in the receiver. Basically, you don’t take into consideration that different filters will cause different delays and that this must be considered when selecting the sampling time.

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**11-17/0964r0 “Signal Bandwidth and Sequence for OOK Signal Generation” (Eunsung Park, LGE):** For the case that the WUR is generated using 13 sub-carriers with 312.5kHz spacing, different designs to generate the signal. Basically, what sequence to use as input to the IFFT block. One of the designs was based on minimizing the PAR of the signal, some others on reusing the sequences used for L-STF or L-LTF

**Q:** I don’t think PAR is a main issue, compared to the main radio

**A:** I basically agree

**Q:** Don’t think we need to specify the signal design. It can be left for implementation.

**Q:** I do believe we want to define how the signal is generated.

**Strawpoll:**

* Do you agree to add the following to the 11ba SFD?
	+ When the subcarrier spacing is 312.5KHz and a single band is used for transmission of wake-up packet, the OOK waveform of wake-up packet is generated by using contiguous 13 subcarriers
		- The center subcarrier should be null

**Y/N/A:** 19/0/36

There was a rather lengthy discussion whether the center sub-carrier needs to be zero. It is agreed that this is god if the signal is sent in the center of the channel. If not transmitted in the center where the center would be DC, the center is still zero in order to have the same signal waveform.

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

**Monday, July 10, 2017, 4:00-6:00 pm**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-04-00ba-july-2017-tgba-agenda.pptx>

* + 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 May 2017 meeting
	+ Motion: March 2017 meeting minutes ([doc: IEEE 802.11-17/0843r0](https://mentor.ieee.org/802.11/dcn/17/11-17-0843-00-00ba-meeting-minutes-may-2017.docx)) and teleconference calls minutes (doc.:IEEE 802.11-17/0895r2)
	+ TGba Spec Framework Document review and approval
	+ Review 11-17/982r1 TGba Use Case Document review and approval
	+ Presentations, Recess

**Chair Minyoung Park (Intel) calls meeting to order at 4.00 pm. (**About 55 persons in the room.)

Minyoung goes through the agenda document 11-17/0545r4. The main topics and the presentations were reviewed in detail this morning, and is therefore only briefly discussed.

Minyoung asks if there are any questions on the submissions. No questions asked.

Minyoung goes through the agenda for the week.

**Motion to approve the agenda**

Move: Yunsong Yang

Second: Xiaofei Wang

Motion passed by unanimous consent.

Minyoung reads through the slides about *Participants, Patents, and Duty to Inform* (slide 21), *Patent Related Links* (slide 22), makes a *Call for Potentially Essential Patents* (slide 23). No potentially essential patents reported and no questions asked.

Minyoung shows *Other Guidelines for IEEE WG Meetings (slide 24), Participation in IEEE 802 Meetings (slide 25),* and where to find more relevant information (slides 26-28), and people not familiar are encouraged to read these slides.

Minyoung goes through the summary of the May meeting (slide 29). The key achievements were:

* Approved initial draft of TGba Spec Framework Document (SFD) [11-17/575r0]
* Reviewed technical presentations
	+ PHY and MAC
	+ Made progress reaching consensus on basic design of PHY/MAC
		- The passed motions recorded in TGba SFD r1 (11-17/575r1)
* Reviewed TGba task group documents
	+ Usage model document
	+ Simulation Scenarios and Evaluation Methodology Document
* Reviewed the TG timeline
* Set goals for the July 2017 meeting and teleconference schedule
* Agenda: see doc.: IEEE 802.11-17/545r11

**Motion (slide 30):** Approve TGba minutes of May 2017 meeting [[doc: IEEE 802.11-17/0843r0](https://mentor.ieee.org/802.11/dcn/17/11-17-0843-00-00ba-meeting-minutes-may-2017.docx)] and teleconference call minutes [doc.:IEEE 802.11-17/0895r2]

Move: Yunsong Yang

Second: Eunsung Park

Motion passed by unanimous consent.

**Review of document 11-17/0575r1 “Specification Framework for TGba”, (Po-Kai Huang)**

Po-Kai explains that the document has been updated in agreement with what achieved during the May f2f meeting.

No question or comments on the document.

**Motion:** Move to approve the document 11-17/0575r1 as the revised TGba Specification Framework Document.

Move: Po-Kai Huang

Second: John Notor

Motion passed by unanimous consent.

**11-17/0982r2 “More on the wake-up AP usage model”, (Eduard Garcia-Villegas, UPC):**

The proposed wake-up AP usage model was approved, but then when to be included in the WUR usage model document some concerns were raised. This presentation is a review of the wake-up usage model in order to address the concerns.

One concern was that the energy savings that would be obtained would be so small that the use case could not be justified. This concern was addressed by referring to studies where significant savings had been reported. The major concern, however, was that it would require additional work which would be outside of the scope of the TG.

**Q:** The comment from Adrian in the last meeting was really that we need to make other changes to the specification.

**A:** I agree that one needs to define what it means for an AP to be in power save, but the protocol for putting the AP in power save is already there.

**Q:** The basic assumption today is that the AP is always available (whether it happens to be in sleep mode or not). You propose to change this so that there can be a situation where the AP may not be available.

**Q:** There is a difference if the AP is turned off manually or put in sleep mode by another STA in that the latter option would require support in the specification.

**Q:** I agree that the use case is interesting, but I believe it is out of the scope of the TG. One example where this makes a difference would be radar detection. Today, an AP would detect a radar signal and then move to another channel after having informed the associated STAs. In case of a sleeping AP, it is not clear how this would be achieved.

**A:** I believe this is not about how to put the AP to sleep, but rather how to wake it up. I have not really thought about the radar problem. So I don’t believe we need a protocol to put the AP to sleep.

**Q:** I think it possible to allow this with a limited impact, although some impact likely is needed.

**Q:** AP power saving mode does not exist, so it will need additional work that is not within the scope of TG 802.11ba. Since we have a very tight time-line, I do not believe we can add such a feature to scope of the TG.

**Q:** I believe this is very relevant and believe we should address this use case in some way.

**Straw Poll:**

Would you approve a usage model document including the wake up AP model, as described in 11-17-0029r7 (slide 17)?

* 1. Yes, the wake up AP model is fine as it was already approved.
	2. Yes, only after a revision of the wake up AP usage model.
	3. No.
	4. Abstain.

**1/2/3/4:** 0/14/9/12

**Review of 11-17/0029r9: WUR Usage Model document (Ross Yu)**

The difference compared to the previous revision is that the AP usage model has been removed.

**Motion:** Move to approve this document (11-17/0029r9) as the draft TGba Usage Models document

Move: Ross Jian Yu

Second: Yunsong Yang

Y/N/A: 11/5/14

Motion fails.

**11-17/0964r2 “Signal Bandwidth and Sequence for OOK Signal Generation” (Eunsung Park, LGE):** This is a continuation of the presentation from the previous session.

**Straw Poll 2:**

* Which option do you prefer for the sequence that is applied to 13 subcarriers to generate 4us OOK ON-signal when the subcarrier spacing is 312.5KHz and a single band is used for transmission of wake-up packet?
	+ Option 1 : [1,1,1,-1,-1,-1,0,-1,1,-1,-1,1,-1]
	+ Option 2 : [1,-1,1,-1,-1,1,0,-1,-1,1,1,1,1] \* (1+j)/sqrt(2)
	+ Option 3 : [1,-1,1,1,1,1,0,1,-1,-1,1,1,-1]
	+ Option 4 : [-1,-1,-1,1,1,-1,0,-1,-1,-1,1,-1,1]
	+ Option 5: None of the above
	+ Abstain

**Op1/Op2/Op3/Op4/Op5/A:** 8/10/2/1/17/3

**11/17-1017r0 “Variable signal bandwidth of the wake-up signal for enhanced WUR performance”, Leif Wilhelmsson (Ericsson):** The presentation proposes to take advantage of transmitting the wake-up signal using a wider bandwidth than the 4 MHz mainly discussed up until now. In regions where the signal effectively is PSD limited, the TX power may be increased around 6 dB, and taking into account the enhanced frequency diversity obtained from the wide bandwidth in total around 10 dB better link budget can be obtained.

**Minyoung declares the meeting to be in recess at 6.00 pm.**

**Tuesday, May 11, 2017, 8:00-10:00 am**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-04-00ba-july-2017-tgba-agenda.pptx>

* 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 pm. (**About 35 persons in the room.)

Minyoung reminds about taking attendance.

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

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

**Presentations:**

**11-17/0953r0, “WUR-Mode-Discussion”, (Suhwook Kim, LGE):** The presentation is concerned with the different modes that have been discussed. The target is to more precisely define what the different modes mean.

**Q:** In general I agree, but I would prefer if we can make things as simple as possible and without involving the main radio is the sense that we need to define new modes also for the main radio.

**Q:** On slide 8, this is all about how the WUR works, but power saving modes in general also involves the main radio.

**11-17/0954r0, “WUR-Mode-Signaling”, (Suhwook Kim LGE):** This presentation may be seen as a continuation of 11-17/0953r0, where the actual signaling is discussed. In particular, explicit and implicit signaling for informing about the mode of the WUR is discussed.

**Q:** This need for new signaling presented here is really what I am concerned about. I believe it is possible to achieve what we want without impacting the main radio protocol this much.

**Q:** On slide 5, can the STA not go from the PS mode to a WUR mode?

**A:** The figure is somewhat simplified, we can define a transition from PS mode to a WUR mode.

**11-17/0972r0, “Definition of WUR Mode”, (Po-Kai Huang, Intel):** The idea is that there is no need to define a new power management mode for WUR mode. Instead, the idea is to simply define that a STA follows the duty cycle schedule agreed between AP and non-AP STA when the STA is in the Doze state. Some additional description is believed to be needed for scheduled power save protocols, but not for the unscheduled ones. This is intended to serve as a basis, but does not exclude the possibility to make further additions.

**Q:** How can a STA exit WUR mode?

**A:** We expect that would require explicit signaling.

**Q:** Once a complete transmission of a data packet to the STA is done, including the ACK from the STA to the AP, if another packet is to be transmitted does it still has to be done by first sending a wake-up packet.

**A:** Yes

**Q:** You are using WURx instead of WUR in some places, what does it mean?

**A:** It means that it is the actual receiver. WUR may refer also the transmitter side. I just wanted to make this clear.

**Straw Poll 1:**

Do you support that if a non-AP STA is in WUR mode, then

* the non-AP STA’s WURx follows the duty cycle schedule (including WURx always on) agreed between AP and non-AP STA if the non-AP STA is in the Doze state
* the existing negotiated service period between AP and non-AP STA for the non-AP STA’s PCR schedule (ex. TWT, schedule for WNM Sleep Mode) is suspended
	+ STA is not required to wake up during the service period if the service period is suspended
	+ The parameters of the negotiated service period for the non-AP STA’s PCR schedule is still saved by the AP and non-AP STA when the negotiated service period is suspended

**Y/N/A:** Deferred

**11-17/0968r1, “Further Consideration of WUR Acknowledgement Indication”, (Kaiying Lv, ZTE):** The considered problem relates to what is the most efficient way to acknowledge the reception of a wake-up packet. In particular, if many STAs are woken up a single wake-up packet, it may be more efficient if the AP sends a Trigger frame to collect responses from the STA.

A WUR packet should indicate how the reception of a wake-up packet will be indicated. The AP can indicated it will send a Trigger frame or it can indicate that it will not send a Trigger frame so that the STA has to perform the default channel access procedure.

**Q:** Do you want to change the procedure already agreed in the SFD?

**A:** No, but in case several STAs are woken up I want that the AP should have the possibility to send a Trigger frame to determine whether the wake-up packet was correctly received.

**Q:** On slide 6, do you propose to use the 802.11ax Trigger frame? What if 802.11ax is not supported?

**A:** The Trigger frame is meant in more general terms to trigger transmission of ACKs of the wake-up packets.

**Straw Poll 1:**

Do you support adding the following to 11ba SFD?

An indication may be carried in the unicast/multi-user wake-up packet to indicate whether a frame will be sent to trigger the acknowledgement.

**Y/N/A: 5/7/14**

**Straw Poll 2:** Deferred.

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

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

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-05-00ba-july-2017-tgba-agenda.pptx>

* 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 70 persons in the room.)

Minyoung reminds about taking attendance and goes through the agenda.

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

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

**Presentations:**

**11-17/0972r1, “Definition of WUR Mode”, (Po-Kai Huang, Intel):**

**Straw Poll 1:**

* Do you support that if a non-AP STA is in WUR mode, then
	+ the non-AP STA’s WURx follows the duty cycle schedule (including WURx always on) agreed between AP and non-AP STA if the non-AP STA is in the doze state
	+ the existing negotiated service period between AP and non-AP STA for the non-AP STA’s PCR schedule (e.g. TWT, schedule for WNM Sleep Mode) is suspended
		- STA is not required to wake up during the service period if the service period is suspended
		- The parameters of the negotiated service period for the non-AP STA’s PCR schedule is still saved by the AP and non-AP STA when the negotiated service

**Y/N/A: 18/0/11**

**11-17/0954r1, “WUR-Mode-Signaling”, (Suhwook Kim LGE):**

**Straw Poll 1:**

* Do you agree to modify the text in SFD as follow?
	+ WUR mode signaling shall be defined for the WUR STA to enter the WUR mode by explicit signaling
		- ~~Explicit or implicit signaling is TBD~~
		- ~~If signaling is explicit,~~ WUR mode signaling is done on the Primary connectivity radio
		- Wake-up operating parameter is ~~may be~~ notified in WUR mode signaling
			* Detailed parameters are TBD

**Y/N/A: 14/0/18**

**11/17-1017r2 “Variable signal bandwidth of the wake-up signal for enhanced WUR performance”, Leif Wilhelmsson (Ericsson):** This is a continuation of the presentation in an earlier session.

**Q:** With a large bandwidth of the channel selective filter, ACI will be more of a problem.

**A:** I added a slide with some simple calculations, showing that a second order Butterworth filter would suffice. What can be noted is that since the WUR must be able to operate at much lower C/N than the main radio, the required suppression of ACI will be correspondingly less.

**Q:** What is the sampling rate of the ADC?

**A:** 1 MHz

**Q:** I am concerned with the power consumption of the CSF

**A:** You can always use the more narrowband filter, and then there should not be any difference in power consumption. The only time when there is a cost in terms of power consumption is when you really need to use the wideband filter to get the required performance.

**Straw Poll 1:**

* Do you support to add to the SFD that the wake-up signal may be transmitted using different bandwidths, e.g. depending on sensitivity requirements for the WURx**?**

**Y/N/A: 16/17/21**

**11/17-1018r2 “Some Results on Synchronization Performance”, Dennis Sundman (Ericsson):** The presentation is concerned with how long syncword is needed for some possible data rates and bandwidths of the wake-up signal. Specifically, it is argued that it would be beneficial to use different syncwords depending on what MCS is used for the data. It is also shown that if the wake-up signal is transmitted using a larger bandwidth the duration of the syncword as well as the data portion of the packet can be reduced, leading to higher efficiency.

**Q:** What was the sampling rate

**A:** 1 MHz, just as in 11/17-1017

**Q:** In the correlator, you search for the peak rather than comparing to a threshold

**A:** Yes, that is correct.

**Q:** On slide 5, how would that work with the AGC.

**A:** We have not really thought about that, but it must be short in relation to the symbol rate.

**11-17/1013r1, “Considerations on WUP bandwidth and CCA”, (Jinsoo Ahn, Yonsei Univ.):**

The presentation is concerned with a that a narrowband signal may cause coexistence issues as it may not be as easily detectable because of the lower transmit power,

**Q:** I think you have a good point. I think this is good to keep in mind, and I think we should limit the duration of the wake-up packets in order to avoid this problem.

**Q:** If you receive the preamble, there should be no problem.

**A:** Correct.

**Q:** On slide 3, I don’t agree that the PSD should be the same for the WUR. In fact you want as high power as possible.

**Q:** On slide 6, I think sending data adjacent with the wake-up signal will cause problem.

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

**Tuesday, May 11, 2017, 4:00-6:00 pm**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-06-00ba-july-2017-tgba-agenda.pptx>

* 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 40 persons in the room.)

Minyoung reminds about taking attendance and goes through the agenda.

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

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

**Presentations:**

**11-17/1000r1, “WUR coexistence with existing power save mode”, (Woojin Ahn WILUS):** The presentation is concerned with WUR mode transitions along with the existing power save mode.

**Straw Poll 1:**

* Do you support the following?
* A non-AP STA may use both PS mode and WUR mode simultaneously
	+ If the non-AP STA is using one of unscheduled power save protocols (e.g., normal PS mode, U-APSD), it may not wake-up to receive Beacon frame

**Y/N/A: 3/0/21**

**Straw Poll 2:**

* Do you support the following?
* Unicast wake-up packet shall contain an information to assist wake up response behavior of the destined STA
	+ E.g., AC information of buffered BUs for the destined STA

**Y/N/A:** 9/3/12

**Straw Poll 3:**

* Do you support the following?
* If a WUR non-AP STA uses U-APSD, all ACs shall be set to trigger/delivery-enabled AC

**Y/N/A:** 4/4/18

**11-17/1012r1, “WUR with conventional 802.11 power save follow up”, (Jinsoo Ahn, Yonsei Univ.)**

**Q:** On slide 7, after receiving the WUP, how does the STA know that it will receive a XXX. I believe more information is needed.

**A:** Maybe you are correct.

**Straw Poll:**

* Do you agree the following?
	+ 802.11ba shall define WUR procedures operated with conventional 802.11 power save procedures and WUR configuration procedures in conventional 802.11 power save procedures.

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

**11-17/1015r2, “Status mismatch problem in WUR transmission procedure”, (Hanseul Hong, Yonsei Univ.):**

**Q:** On slide 6, I don’t really understand the reason why the STA wakes up if it has nothing to transmit.

**Straw Poll:**

* Do you agree with the following sentence?
	+ TGba should consider mechanism to combat the inefficiency in case AP transmits wake-up frame to STA in awake state

**Y/N/A:** 8/0/18

**11-17/984r1, “WUR Mode Transition Mechanism”, (Yongho Seok, MediaTek):** The presentation is concerned with when the STA enters and exists the WUR mode.

A STA can enter the PS mode at any time, but what is entering the WUR mode? It is suggested that the STA can only enter the WUR mode if the AP does not have any buffered data.

It has been agreed that any response frame from the 802.11 main radio can be used to indicate that the STA is in the Active mode or PS mode, but this may have some security issues. It is therefore suggested that the AP can request to use the protected frame as the response frame.

**Q:** I don’t think you need to specify this. I don’t see that in practice a STA will enter the WUR mode if there is data to it.

**Straw Poll 1:**

* Do you support the following WUR Mode Transition Mechanism?
	+ A STA in WUR mode should enter the doze state only if the AP does not have any buffered frame individually to be addressed to the STA and also the STA’s buffers are empty.

**Y/N/A:** 4/1/24

**Straw Poll 2:** Deferred

**Straw Poll 3:** Deferred

**Straw Poll 4:**

* Do you support the following?
	+ An AP and a STA can negotiate if the response frame transmitted to the AP using primary connectivity radio after receiving a unicast wakeup packet shall be the protected fram

**Y/N/A: 2/3/24**

**Minyoung declares the meeting to be in recess at 6.00 pm.**

**Wedensday, May 12, 2017, 8:00-10:00 am**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-06-00ba-july-2017-tgba-agenda.pptx>

* 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 40 persons in the room.)

Minyoung reminds about taking attendance and goes through the agenda.

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

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

**Presentations:**

**11-17/1037r2 Performance Evaluation of OOK Waveform Coding Schemes with Impairments, Rui Yang (InterDigital):** Different waveforms for the OOK signal are compared, and the impact of impairments on the different waveforms are studied. In particular sequence based generation is shown to result in significantly less ACI than mask based generation of the waveform.

**Q:** For the masking, did you use a square mask? Because it would be possible to use another window to improve spectral behavior.

**A:** You are correct, we used a square mask and I agree that it is possible to obtain better results with another mask.

**Q:** On page 5, you always use three symbols?

**A:** Yes.

**Straw Poll 1:**

* Do you think the TGba should agree on a set of requirements for waveform, e.g., PAPR, ACI, ACR, before making the decision on waveforms?

**Y/N/A:** 5/1/14

**Straw Poll 2:**

* Do you agree that the concurrent transmission with 11ax signals (as current defined in the 11ax spec draft) should be one of the 11ba system capabilities?

**Y/N/A:** 2/4/13

**Straw Poll 3:**

Do you agree that frequency domain multiplexing transmission of multiple WUSs should be one of 11ba system capabilities?

**Y/N/A: 15/2/6**

**11-17/0965r0, ”Data rate for range requirement in 11ba”, (Eunsung Park LGE):** Performance for various data rates are simulated and compared to the performance of the main radio.

**Q:** You have worse results for 5 GHz, is that because the CFO is higher with the same relative accuracy.

**A:** Yes, I believe so.

**Q:** I believe the filter you use is too poor.

**Q:** I believe we should both considered low rate for sufficient range and high data rate for better efficiency. Have you for instance calculated the needed transmission time for sending a packet?

**Q:** I am concerned that we are overdesigning, and may miss the target of a low power design.

**11-17/0966r1, “Data Rate Selection for Wake-Up Receiver”, Kaiying Lv (ZTE)**

**Q:** I understand it as you want to define a packet which can be used to determine a suitable data rate to use for the WUR. I wonder if we cannot just send a packet and rely on the CRC?

**A:** The idea was that this would be more efficient.

**Q:** I believe main radio is also useful to estimate the radio link quality.

**Straw Poll 1:**

* Do you agree to add the following to the 11ba SFD?
	+ WUR measurement protocol should be defined in 11ba

**Y/N/A:** 6/2/17

**Straw Poll 2:**

* Do you agree to add the following to the 11ba SFD?
	+ A WUR measurement packet supporting multi-rate measurement should be defined in 11ba as shown in slide 4

**Y/N/A:** 2/8/17

**Straw Poll 3:** Deferred

**11-17/0990r0, ”WUR Data Rates” (Steve Shellhammer and Bin Tian, Qualcomm):**

**Q:** I think it is good to not only focus on meeting the range, but also address situations where most WUR can be expected to operate.

**Q:** I have a comment to the BCC. I disagree that with the power consumption calculations. Wheneven the WUR is on, it has to decoded in order to determine whether the packet is for itself or not. I also believe there are memory leakage. You are assuming that you have the BCC in the main radio, but e.g. 11b does not have BCC.

**A:** I agree that you have to decode every packet, but that is only every 10 s or so. I don’t think memory leakage is such a big thing.

**Q:** The PAR talks about power consumption in active state, so it is not really relevant ot talk about the average for the BCC.

**A:** In principle, as there is no hard requirement for the decoding time, you can

**Q:** We may not have a BCC available. This is a relatively large addition as the digital part is very small.

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

**Thursday, May 13, 2017, 8:00-10:00 am**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-07-00ba-july-2017-tgba-agenda.pptx>

* 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 reminds about taking attendance and goes through the agenda.

Minyoung asks if there are any questions on the agenda. A minor correction is made, as one presentation was erroneously marked as presented. This is corrected.

**Motion to approve the agenda**

**Move:** Po-Kai Huang

**Second:** Steve Shellhammer

Motion passed by unanimous consent.

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

**Presentations:**

**11-17/0965r1, “Data Rate for Range Requirement in 11ba”, (Eunsung Park, LGE):** The contribution presents simulation results for different data rates and relate the results to the PAR requirements.

**Straw Poll 1:**

Do you agree to use binary convolution code (BCC) rate 1/2 as in the 802.11 spec for the payload part of wake-up packet?

**Y/N/A:** 10/11/12

**Straw Poll 2:**

Which data rate do you agree to use as the lowest data rate for the payload part of wake-up packet?

* + 15.625Kbps
	+ 31.25Kbps
	+ 62.5Kbps
	+ 125Kbps

**15.625/31.25/62.5/125/A:** 0/11/27/4/6

**11-17/0990r2, ”WUR Data Rates” (Steve Shellhammer and Bin Tian, Qualcomm):** The presentation shows simulation results for different data rates and relates the performance to the PAR requirement. It is proposed to support to data rates, 250 kb/s and 62.5 kb/s. To achieve higher data rate, the Manchester coded data is obtained by for each OFDM symbol either let the first part or the second half equal zero.

**Straw Poll:**

Do you support the following?

* IEEE 802.11ba will support the following data rates: 62.5 and 250 kb/s
	+ Support of any data rates higher than 250 kb/s is TBD

**Y/N/A: 35/0/4**

**11-17/0997r0, “Preamble-options”, (Shahrnaz Azizi, Intel):** The presentation is related to whether to have a common preamble or to have different preambles for different rates.

**Q:** Do you do energy detection first?

**A:** We only use in-phase component I should add. No we don’t do any energy detection first.

**Q:** How do you get three peaks?

**A:** The sliding window is 30 bits, so we will get two peaks of half the height at each side as the PN sequence is of length 15.

**Q:** Since it is OOK, have you thought about how this will impact the AGC?

**A:** We don’t believe the AGC is a problem, even if there would be some saturation.

**Q:** In the correlator, do you have a fixed threshold?

**A:** In these simulations, we use a threshold that is dependent on the received SNR.

**Straw Poll:**

Do you support

Option 1: Common preamble

**Y/N/A:** 13/1/28

Option 2: Different preambles to indicate different rates

**Y/N/A:** 5/4/36

**11-17/0983-r0, “WUR preamble SYNC field design”, (Rui Cao, Marvell):** The results presented in this contribution is based on using a coherent receiver rather than an envelope detector for performing synchronization.

**Q:** It seems you don’t have an envelope detector?

**A:** We have a coherent receiver for the sync field.

**Q:** Have you compared the energy detection for the coherent processing compared to using non-coherent processing?

**A:** No.

**Q:** I believe that the PAR asks for low power consumption. I don’t think saving a few bits can be justified if the receiver is much more complicated and consumes much more power.

**Q:** Did you have a silent period before the SYNC field?

**A:** Yes.

**Q:** The power consumption is determined by the search window size, rather than the length of the SYNC field.

**A:** The correlator is smaller, so I believe the length of the SYNC field does matter.

**Straw Poll 1:** Do you agree to design the WUR SYNC field with no-OFF period?

**Y/N/A:** 9/16/16

**11-17/0992r0, “Power save mode for WUR”, (Jason Yuchen Guo, Huawei):** The proposal discusses potential issues for a STA that is both in power save mode and in WUR mode.

**Straw Poll:**

* Do you support that the STA does not need to wake up its PCR periodically to receive the Beacon when the STA uses both the power save mode and the WUR mode simultaneously?

**Y/N/A:** 27/0/16

**Minyoung declares the meeting to be in recess at 10.02 am.**

**Thursday, May 13, 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/17/11-17-0883-08-00ba-july-2017-tgba-agenda.pptx>

* + 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 10.30 am. (**About 75 persons in the room.)

Minyoung reminds about taking attendance and goes through the agenda.

Minyoung has received requests for 5 motions. Minyoung asks if there are additional motions. No response.

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

Based on comment from the floor regarding Q/A procedure in relation to the presentations, Minyoung suggests to discuss this for a short time before continuing with the motions.

One person believes it is not appropriate to cut the queue, but instead people should have the chance to join the queue at any time. Other persons supports the procedure to cut the queue to make faster progress and to some extent limit the discussions. One proposal is brought forward, suggesting to allocate a fixed time for a presentation, implying that a short presentation would have more time for questions.

One person express the opinion that high quality of the specification should have priority before meeting the time-line.

Minyoung decides to try to give each presentation roughly 20 minutes, but not as a hard limit. If there then is a long queue for questions, the queue will be limited.

**Motions:**

**11-17/0964r4, “Signal Bandwidth and Sequence for OOK Signal Generation”, (Eunsung Park):**

Move to add the following to the 11ba SFD?

* + When the subcarrier spacing is 312.5KHz and a single band is used for transmission of wake-up packet, the OOK waveform of wake-up packet is generated by using contiguous 13 subcarriers
		- The center subcarrier of 13 subcarriers can be null

**Move:** Eunsung Park

**Second:** Shahrnaz Azizi

**Y/N/A: 31/2/9**

**Motion passed**

**11-17/0965r1, Data Rate for Range Requirement in 11ba, (Eunsung Park):**

* Move to add the following to the 11ba SFD
	+ The lowest data rate for the payload part of wake-up packet is 62.5Kbps

**Move:** Eunsung Park

**Second:** Suhwook Kim

**Y/N/A: 32/0/11**

**Motion passed**

**11-17/0972r2, Definition of WUR Mode, Po-Kai Huang (Intel):**

* **Move to add the following to 11ba SFD:**
	+ If a non-AP STA is in WUR mode, then
		- the non-AP STA’s WURx follows the duty cycle schedule (including WURx always on) agreed between AP and non-AP STA if the non-AP STA is in the doze state
		- the existing negotiated service period between AP and non-AP STA for the non-AP STA’s PCR schedule (e.g. TWT, schedule for WNM Sleep Mode) is suspended
			* STA is not required to wake up during the service period if the service period is suspended
			* The parameters of the negotiated service period for the non-AP STA’s PCR schedule is still saved by the AP and non-AP STA when the negotiated service period is suspended

**Move:** Po-Kai Huang

**Second:** Suhwook Kim

**Y/N/A: 36/0/9**

**Motion passed**

**11-17/0954r2, “WUR Mode Signaling”, (Suhwook Kim)**

* Move to accept following text modification in the SFD
	+ WUR mode signaling shall be defined for the WUR STA to enter the WUR mode by explicit signaling
		- WUR mode signaling is done on the Primary connectivity radio
		- Wake-up operating parameter is notified in WUR mode signaling

 Detailed parameters are TBD

**Move:** Suhwook Kim

**Second:** Po-Kai Huang

**Y/N/A: 31/0/4**

**Motion passed**

**11-17/1147r0, ”WUR Data Rate Motion”, (Steve Shelhammer)**

Add the following text to the Spec Framework Document (SFD):

* “IEEE 802.11ba will support the following data rates: 62.5 and 250 kb/s
	+ Support of any data rates higher than 250 kb/s is TBD”

**Move:** Steve Shellhammer

**Second:** Jung Hoon Suh

**Y/N/A: 44/0/8**

**Motion passed**

**11-17/992r1, “Power save mode for WUR”, (Jason Yuchen Guo, Huawei):**

Move to add the following to the 802.11ba SFD:

the STA does not need to wake up its PCR periodically to receive the Beacon when the STA uses both the power save mode and the WUR mode simultaneously

**Move:** Jason Youchen Guo

**Second:** Po-Kai Huang

**Y/N/A: 14/10/23**

**Motion failed**

**11-17/0978r2, “Power saving operation for WUR STAs in duty cycle mode”, Jeongki Kim (LGE):** The presentation is concerned with the situation when the STA is in duty cycle mode and how to reduced power consumption in relation to receiving the Beacon.

**Q:** I believe you know the timing of the Beacons, so I don’t think you need to send a WUP for informing about this. Therefore, this does not seem to be necessary.

**Q:** Why use both normal Beacon and WUP to wake up the STA?

**Q:** I believe there is a need for something like this, but I am not sure if this is exactly how we want to address the problem.

**Straw Poll 1:**

* Do you agree the following?
	+ A broadcast wake-up frame contains the following wake-up reason information
		- Option 1: PCR beacon reception information
		- Option 2: PCR DTIM Beacon reception information
		- Option 3: None of the above
		- Option 4: Abstain

**Op1/Op2/Op3/Op4:** 13/9/18/13

**Straw Poll 2:** Deferred

**11-17/0991r0   Preamble Design and Simulations (Steve Shellhammer and Bin Tian, Qualcomm):** The presentations shows simulation results when ML sequences are used.

**Minyoung declares the meeting to be in recess at 12.33.**

**Thursday, May 13, 2017, 1:30-3:30 pm**

**Meeting Agenda:**

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

<https://mentor.ieee.org/802.11/dcn/17/11-17-0883-08-00ba-july-2017-tgba-agenda.pptx>

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

**Chair Minyoung Park (Intel) calls meeting to order at 1.30 pm. (**About 35 persons in the room.)

Minyoung reminds about taking attendance and goes through the agenda.

Minyoung asks if there is any comments or questions on the agenda. No response.

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

Minyoung goes through the timeline (slide 33). The timeline has not changed, but we will see what happens in the September meeting. Minyoung asks if there are any questions related to the timeline. No response.

Minyoung goes through the goals for the September meeting (slide 34).

Minyoung goes through the teleconference call schedule (slide 35).

* Proposed schedule (2 hours)
	+ August 14th (Monday), 10:00 ET
	+ August 28th (Monday), 17:00 ET

**Motion to approve the Telephone schedule.**

Move: John Notor

Second: Jinsoo Choi

Motion passed by unanimous consent.

11-17/0188r8 “IEEE 802.11 TGba Simulation Scenarios and Evaluation Methodology Document” (Shahrnaz Azizi, Intel): Shahrnaz presents the updates that have been made to the latest revision of the Simulation Scenarios and Evaluation Methodology Document. Specifically, the SNR definition has been clarified, the phase noise model has been added, and models for channel selective filters to be used in the simulations have been added. Two filters are included, a 2nd order filter and a 5th order filter, suggested to be used depending on of only one WUR signal is sent in the 20 MHz channel or if more are multiplexed in frequency.

**Q:** It says the 2nd order low-pass filter has5 MHz cut-off frequency, should it be 2.5 MHz as for the 5th order filter?

**A:** I believe so, I need to check to make sure and will then change..

**11-17/0991r0   Preamble Design and Simulations (Steve Shellhammer and Bin Tian, Qualcomm):** This is a continuation from an earlier session, where the presentation was made but where there was no time for questions.

**Q:** What does it mean to find the pre-amble compared to find the time-synchronization?

**A:** The preamble is found is the peak value is in the correct symbol. Correct timing would set harder requirements, like within a few samples.

**Q:** I believe the threshold needs to be variable depending on the SNR

**A:** In some way you would typically estimate the received power, I agree.

**Q:** It seems the choice of threshold is very important for the performance.

**Q:** The probability of false alarm is only for noise, if there would e.g. be 802.11ax things would be different

**A:** Agree, we should also look at these cases.

**Q:** Do you also consider the AGC

**A:** No, but we think that the requirements on the AGC is rather relaxed, and maybe we can also use the legacy preamble anyway pre-appending the packet.

**11/17-1020r0, “Follow up on Preamble Design for WUR”, (Tianyu Wu, MediaTek):**

**Q:** You run several correlators in parallel?

**A:** Yes, in our opinion the correlators are not very power consuming.

**11-17/0963r0, “Signaling method for multiple data rates”, (Dongguk Lim, LGE):** Two methods for signaling the data rate are considered in this presentation.

**Q:** You envision that the packet has a SIG field, and that this SIG field carries the data rate information. I don’t understand why you need a CRC for the SIG field, since if you don’t receiver this field correctly, it will not be possible to decode the remaining part of the packet.

**Straw Poll:**

Do you agree to add following into 11ba SFD?

* Signature sequence is used to indicate the data rate for 11ba payload.

**Y/N/A:** 6/1/22

**11-17/1008r0, “Vendor Specific WUR frame”, (Po-Kai Huang, Intel):** The presentation proposes to have a vendor specific WUR frame to allow for future invention in the WFA as well as further inventions from specific vendors.

**Q:** Can you give an example of an application more that wake-up of the main radio. The scope of this project is wake-up radio, and you now ask us to prepare for something else. I would be more comfortable if I had an idea of what you have in mind.

**A:** I agree this is not in the scope, but we can’t predict the future and want to prepare for it.

**Q:** It does not cost a lot in terms of bits?

**A:** Correct.

**Q:** I am also in favor of if this can be used for even more applications.

**Meeting is adjourned at 3.30 pm.**