IEEE P802.11  
Wireless LANs

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| IEEE 802.11 TGbp Ambient Power Communication  July 2024 Plenary Meeting Minutes  Montréal, Canada | | | | |
| Date: 2024-07-22 | | | | |
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Abstract

Rev 0: This document contains the IEEE 802.11 TGbp July 2024 Plenary meeting minutes.

TG Chair: Bo Sun (Sanechips)

TG Vice Chairs: Steve Shellhammer (Qualcomm)

Rakesh Taori (Infineon)

TG Secretary: Sebastian Max (Ericsson)

TG Technical Editor: Yinan Qi (OPPO)

Abbrevations:

Q Question

A Answer

C Comment

SP Straw Poll

# Monday AM1 (2024-07-15T08:00-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r2).

* Chair calls the meeting to order at 08:00 EDT.
* Chair instructs members to record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the current TGbp session submission list (slide 15), the meeting agenda for the week (slide 16), and the distribution of submissions to the meeting slots.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r02 (slide 18).

* + Call meeting to order and remind the group to record attendance on imat.ieee.org
  + IEEE-SA IPR policies and meeting rules
  + Approve meeting agenda
  + Approve TG minutes
  + Contribution discussion
    - 11-24/0897, TGbp selection procedure, Bo Sun (Sanechips)
    - 11-24/0900, Wireless Power Transfer and Frequency Regulation, Joerg Robert (TU Ilmenau/Fraunhofer IIS)
    - 11-24/1180, reference model of AMP only IOT devices, Solomon Trainin (Wiliot)
    - TBD
  + Any other business?
  + Recess

Chair calls for approval of the agenda of the TGbp session.

No discussion, no objection, agenda approved.

## Motion: Approve TGbp Meeting Minutes

Approve the meeting minutes for TGbp meetings during 802 May interim session as below:

https://mentor.ieee.org/802.11/dcn/24/11-24-0953-00-00bp-2024-05-interim-meeting-minutes.docx

Moved: Sebastian Max

Seconded: Rakesh Taori

Result: Approved with unanimous consent

## TGbp Selection Procedure (IEEE 802.11-24/0897)

Presentation of IEEE 802.11-24/0897r1, 11bp selection procedure, Bo Sun (Sanechips)

Q: The Specification Framework Document (SFD) proposal is the motion text?

A: Yes.

Q: Can text be added to the Specification Framework Document before the Functional Requirement Document (FRD) is complete?

A: FRD helps to form the SFD. There can be overlap in time to work on the documents.

Q: Is there a skeleton for the SFD?

A: Technical Editor will have to work out a skeleton. Please have offline discussion with the Technical Editor.

Motion to approve the procedure will be run on Thursday.

## Contributions

### Presentation of IEEE 802.11-24/0900r0, Wireless Power Transfer and Frequency Regulation, Joerg Robert (TU Ilmenau/Fraunhofer IIS)

Q: Only the strongest signal is received – what about if Manchester encoding is used?

A: Presentation shows how UHF-RFID is used, we can do it differently.

Q: Slide 10. RFID has 4 channels. Reader signal is very narrow, but the receive bandwidth of the tag is wide. So only one channel at a time can work?

A: It's limited by the regulation. But there can be multiple readers at the same time.

Q: If we have an active transmitter in 2.4GHz, can we still do power transfer in 1GHz?

A: Regulation leaves a lot of room for interpretation. Probably yes.

Q: Channel bandwidth limits also apply to wireless power transfer?

A: There are no rules specific to power transfer, so we need to use the existing rules. Change of rules would take a long time. In the US, the 500kHz regulation would probably be the right choice.

Q: Regarding collisions / strongest signal is detected. How much more SNR dB is needed?

A: I can't give an answer, depends on the implementation of the tags and the reader. Normally the strongest signal will win. But we can design it differently.

Q: Is there a behavior for multiple readers to avoid collisions?

A: Readers do Listen-Before-Talk in UHF-RFID.

Q: Slide 6. Can there be a delay between the carrier signal and the DL signal?

A: Carrier signal must be there all the time. Tags will lose power otherwise. Only in the "off" period in the OOK it's not present, but this is kept very short.

Q: Slide 9. FCC requires frequency hopping, but I've never seen the bandwidth requirement of 500kHz or 1.25MHz.

A: It's a bit hidden in the regulations. 6dB bandwidth is defined as 500kHz (minimum bandwidth). For the frequency hopping 25 or 15 channels are required. The transmit power depends on number of channels, so for the maximum transmit power 15 channels are needed.

Q: Slide 6. Two circuits are shown (demodulation and energy harvesting). Is there a switch, or power split?

A: Interesting question, I'm not able to answer. Yes, there can be a switch. DL is limited by the energy harvesting anyways. C4 is very small compared to C2, so most of the energy goes to C2. Figure shows the classical structure.

Q: Slide 9. Goal to minimize interference to existing devices is very reasonable, fully agree.

A: There are 1000s of devices already deployed and operating in 1GHz.

Q: Carrier wave (CW) vs. minimum bandwidth in FCC?

A: CW is used for UHF-RFID with hopping (after 4ms) to conform to the minimum bandwidth. But we might design it differently.

Q: Slide 6. Harvester shorts the demodulator, so there needs to be a switch / impedance change to allow the operation of the demodulator.

A: Yes, diagram is simplified.

### Presentation of IEEE 802.11-24/1180r1, Reference model of AMP only IOT devices, Solomon Trainin (Wiliot)

Q: Agree with conclusion. Slide 10. This is not the full picture, there's a read/write command in RFID. Maybe it's a little bit early to say all frames are command frames. Will there be a different reference model for AMP-assisted STAs?

A: Reference model can be different for AMP-assisted, approach may be different.

A: The picture on slide 10 is only an example.

C: AMP may not use the IEEE 802.11 frame structure.

A: A new, different frame format can be invented.

C: TG should reach out to the architecture SC, they will have opinions, we should align early.

Q: Term "interogator" and "tag". We're using AP and non-AP STA in 802.11. Are they mapped to each other?

A: Decided to use different words than AP and STA to make sure no implications are made.

Q: Do we need to specify application-layer types of protocol if we chose option 2?

A: No, there can be MLME-SAP specific to AMP.

Q: Agree with option 2. However, can the management entity send frames directly through the PHY, without the MAC?

A: No. Intention is to have AMP IoT management entity that builds the mac frames.

C: If we change the reference model, then we should go through the Architecture Standing Commitee (ARC SC).

A: Agree, but we should be aware ARC SC is not very fast. Furthermore, first we need an agreement in TGbp. Currently we don't have an agreement.

Q: Slide 9. Agree that discussion is important. What is missing what "AMP IoT management entity" interface defines, and the definition of the primitives.

A: Primitives will be defined in the next step.

Strawpoll will be run on Thursday in the closing meeting.

## Recess

The chair announced the session recessed at 10:00 EDT.

Next session will be on July 15th PM1.

# Monday PM1 (2024-07-15T13:30-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r3).

* Chair calls the meeting to order at 13:30 EDT.
* Chair instructs membersto record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the agenda for the meeting slot.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r03 (slide 21).

* Call meeting to order and remind the group to record attendance on imat.ieee.org
* IEEE-SA IPR policies and meeting rules
* Approval of agenda
* Contribution discussion
  + 11-24/1163, WUR for Integrated Energizer Case, Steve Shellhammer (Qualcomm)
  + 11-24/1198, UL Data Rate for AMP, Yinan Qi (OPPO)
  + 11-24/1199, PHY Design for AMP, Yinan Qi (OPPO)
  + 11-24/1210, 802.11 Features Re-use, Vytas Kezys (HaiLa)
  + TBD
* Any other business?
* Recess

Chair calls for approval of the agenda of the TGbp session.

No discussion, no objection, agenda approved.

## Contributions

### Presentation of IEEE 802.11-24/1163r0, WUR for Integrated Energizer Case, Steve Shellhammer (Qualcomm)

Q: Slide 3. Is that full duplex?

A: The figure is not implying that they operate at the same time. DL and UL happen at different times.

Q: How is the AP not saturated when transmitting the energy?

A: Not focusing on the backscattering problem. Energizing might happen beforehand. There are multiple solutions for the backscattering and the self-interference of the AMP AP.

Q: Slide 12. Is the power consumption for the AP?

A: No, it's for the client.

Q: LNA and analogue baseband might not fit the power requirements previously discussed. We should add power consumption numbers, and how much energy a device can harvest.

A: Agree. LNA might not be the right term, can be some kind of amplifier. In the analog baseband at least some filter and A/D converter is needed. However, they will be similar to 11ba.

Q: Slide 15. Increase data rate / shorten airtime is good direction. Do we need to define if it's MC- or SC-OOK?

A: Maybe not. MC-OOK makes the signal wider, maybe that's not intended.

Q: Calculations of durations also contain the legacy preamble?

A: No, it does not change.

Q: Slide 15. Propose SC-OOK, what is the advantage? Shall we design a unified SC-OOK waveform for the integrated and the separated case?

A: In 11ba we had to use MC-OOK to cover a wider bandwidth. Now the rate SC-OOK already has 4MHz. Have not thought about high-rate MC-OOK.

Q: Regarding the use case: Is 2.4GHz used for joint energizing and DL transmission?

A: No, RF energizer should be sub-1GHz. Only communication is 2.4GHz here. Calculations on slide 4 are for 1GHz in the top part, then 8.5dB is added to account for the data communication in 2.4GHz.

Q: How shall the preamble look like? WUR-like?

A: Preamble design is an independent decision.

Q: Maybe 11b preamble design if we move to SC?

A: Yes, did not think of that.

C: Communication link is not the problem for the link budget, only the power transfer.

A: Yes, absolutely. Power transfer limits the link budget.

Q: Then we can go to high data rates for the UL. For the DL not sure if that is possible, creates inter-symbol interference. Also, preamble detection consumes power.

A: (i) Not really high symbol rates. (ii) did not check power consumption for sync field detection.

Q: Why not increase range if we have a good link budget?

A: Presentation is about integrated energizer. For external / non-rf-power energizing the link budget is decoupled from the energy source, and range can be on-par with the regular Wi-Fi.

Q: Did you look at WUR combined with energizer at sub-1 GHz?

A: Assumption is low-accurarcy clock for the receiver. Can look at sub-1GHz WUR. This would be a third downlink.

C: We need to improve the UL data rate.

### Presentation of IEEE 802.11-24/1198r0, UL Data Rate for AMP, Yinan Qi (OPPO)

Q: High data rate (1Mb/s) is helpful. Need to answer which low data rate is needed for the coverage.

A: Need to design considering multiple factors, e.g., target supported coverage. Many proposals, but no conclusion.

Q: Maybe repeat excercise done by Steve for different rates? Maybe we can do even more than 1Mb/s, up to 16Mb/s. The receiver for the UL has high capability.

A: Yes, agree.

C: For the short-range integrated energizer case the multipath model of TGn might not be appropriate. Special channel models are needed.

Q: Slide 9. 2B for the address, is that sufficient?

A: Communication is only between STA and AP, no peer-2-peer. So, the MAC address can be a short id.

Q: What about collisions, with 16bit it's far from zero probability?

A: Yes, need to check this.

C: Important use cases for smart home are a door lock, doorbell, security camera. Always at least one wall in between.

C: Don't mandate high rates.

C: There's no need for the legacy preamble in the uplink.

C: Higher rates will save energy.

Q: Slides 8 & 9. Proposal is for the AMP. Is it the same for the UL and DL?

A: Only for UL.

Q: What is then the reason for the legacy preamble?

A: It depends on the design. Different options. Generation of legacy preamble is challenging for the AMP device. Maybe just remove it, or it is transmitted by another device.

C: If device is triggered, then no legacy preamble is needed.

Q: Is that single-carrier or multi-carrier?

A: Not studied here.

Q: Tx power -15dB. For the backscatter case it might be even lower. Rx sensitivity -99.5dBm. Why are the values different compared to Steve's contribution?

A: That comes from the different noise figure.

C: All frames have the legacy preamble. The reason is that otherwise the legacy devices will transmit, causing interference, generating hidden nodes.

### Presentation of IEEE 802.11-24/1199, PHY Design for AMP, Yinan Qi (OPPO)

C: The legacy preamble cannot be used in AMP-only UL. Furthermore, payload should be very small, so a legacy preamble reduces the efficiency.

Q: Slide 7. Why 1b parity check?

A: It's from 11a.

Q: AMP SIG should be short. So not many options, data rates, etc. UL and DL might end up different.

A: Should not be too flexible, that's not necessary.

C: Contributions discuss a lot of designs. AMP SIG design is too early now. Legacy preamble is needed.

C: Slide 7. Backscatter indication bit might not be needed.

C: Backscatter can be more than carrier wave backscattering only. AP may transmit a modulated frame, the backscatter only changes bits in the frame.

C: Slide 7, backscatter indication bit. Might be for a mixed scenario, to indicate the carrier wave.

Due to time limits the last scheduled presentation, IEEE 802.11-24/1210, is moved to Thursday AM1.

## Recess

The chair announced the session recessed at 15:30 EDT.

Next session will be on July 16th AM2.

# Tuesday AM2 (2024-07-16T10:30-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r4).

* Chair calls the meeting to order at 10:30 EDT.
* Chair instructs members to record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the agenda for the meeting slot.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r04 (slide 23).

* Call meeting to order and remind the group to record attendance on imat.ieee.org
* IEEE-SA IPR policies and meeting rules
* Approval of agenda
* Contribution discussion
  + 11-24/1194, Capability report for AMP STA, Zhanjing Bao (TCL)
  + 11-24/1197, Consideration on AMP Coexistence, Panpan Li (Huawei)
  + 11-24/1201, Time and frequency synchronization for AMP, Jinyu Zhang (OPPO)
  + 11-24/1208, Thoughts on the AMP WPT protocol, Ian Bajaj (Huawei)
  + 11-24/1263, AMP Supported Legacy Mode, Pooria Pakrooh (Qualcomm)
  + TBD
* Any other business?
* Recess

Chair calls for approval of the agenda of the TGbp session.

No discussion, no objection, agenda approved.

## Contributions

### Presentation of IEEE 802.11-24/1194r0, Capability report for AMP STA, Zhanjing Bao (TCL)

Q: Slide 7. How do you manage channel access for the AMP STAs? Does the AP assign time slots for AMP STAs?

A: Slide 6 shows how the response frame is sent. We don't know yet how the channel access works. The figure is only an example, showing different slots in time. Response frame can be sent in different ways.

Q: Slide 7. Concerned about the trigger frame at every time slot, consumes harvested energy of the AMP STAs. Why is it neccessary at every time slot?

A: Needed for protection window such that legacy STAs do not access the channel. Multiple broadcastings of the trigger frame is needed to collect the information of all AMP STAs. If no feedback is received the reader can terminate the query phase / capability collection. After an ACK'ed response, the queried AMP STA can save power by sleeping.

Q: Isn't it possible to send the trigger by unicast?

A: For the id assignment a broadcast of trigger frames is needed.

Q: Slide 7. Protection window covers more than one slot?

A: Yes. It's an example. First trigger frame starts the protection window and indicates the slot time.

Q: But the TXOP cannot be extended.

Q: Trigger frame is broadcasted. How does the reader know the address of the first STA?

A: Not sure yet if the AMP STA has a MAC address. Response from AMP STA should have a "Transmitter Address" field. AMP STAs must be differentiatable from each other.

Q: How do you guarantee that only one AMP STA responds per slot?

C: Needs further discussion. Figure is just an example. Channel access schemes need to be discussed.

Q: Slide 8. Id allocation. Is that a broadcast scheme?

A: Broadcast or multicast to save time.

Q: SP2. Not specific enough. Id may not be necessary for AMP STAs that have storage, may also operate on random access.

A: Agree.

Q: Slide 9. What if the non-AP STA is not associated to an AP?

A: Then it is similar to the process on slide 8.

Q: Assume an airport scenario with 100s pieces of luggage, and to query if a certain luggage is there or not. In this scenario do you assume the AP knows all MAC addresses?

A: No.

Q: Is there a mechanism to know if all tags have responded?

A: Reader receives AMP response frame with capability, then it knows the AMP STA exists.

Q: Should the AMP STA decide if the reader is the right one to communicate?

A: Trigger frame can indicate the reader's id. AMP STA can decide to send the response or not.

C: Capabilities need to be discussed for the whole AMP application cases.

Q: What about P2P cases where there is no AP? Id allocation might be different.

A: P2P scenario might be similar to slide 7, AP as reader. Need to discuss the security part.

### Presentation of IEEE 802.11-24/1197r0, Consideration on AMP Coexistence, Panpan Li (Huawei)

Q: Generally we like AP has control, and preamble is important. In slide 5 there is a sync requirement.

A: Yes, correct. But no answer yet.

Q: Due to the power asymetry maybe we do not have the problem of a hidden node problem?

A: Not checked, depends on the capability of the AMP STA.

C: Like the idea, we need to reduce the probability of hidden node issues.

Q: Share concerns, maybe there's no hidden node. But why does your proposed solution solve the problem? The Legacy-Preamble-Transmitting (LPT) STA only protects their own neighborhood.

A: We think the legacy preamble is necessary.

Q: Why is the legacy preamble necessary, there is no need? High power AP will protect the TXOP.

A: We want to avoid collision with legacy Wi-Fi devices.

Q: What is the reason for the collision? In the neighborhood the AP makes sure all legacy devices are silent.

Q: What is the relation of LPT STA and AP?

A: Not considered yet. Need to check which LPT STA is most suitable.

C: We can consider whether this issue exists. Maybe just use the trigger to protect the transmission. Large power asymetrie between AP and AMP-STA.

Q: Let's assume we need the LPT STA solution. How does it decide to transmit a legacy preamble? Who is transmitting if there are multiple LPT STAs?

### Presentation of IEEE 802.11-24/1201r0, Time and frequency synchronization for AMP, Jinyu Zhang (OPPO) (presented by Weijie Xu)

Q: Did you assume correlation to do the synchronization?

A: Yes, similar method as in WUR.

Q: How does the correlator work? Very complex to implement in a tiny device.

A: Not so complicated to implement correlator for a single branch. Power consumption can be very low, in the order of µW.

C: Maybe it's not needed at all. No frequency offset estimation needed for OOK.

Q: Slide 5. WUR device does not understand the legacy portion. Carrier Frequency Offset (CFO) sync is done with L-SFT, which is not understood by the receiver.

A: CFO sync is not for the DL signal. Here, check if the device can estimate the CFO for the UL.

Q: Is the CFO intended for the DL reception or for the UL active transmission? What is the purpose?

A: Not for the DL receiver. Calibrate clock based on the DL sync, then do more accurate UL transmission.

Q: The sync should be based on the UL transmission.

A: If we find a simple method to do CFO compenstation on the AMP STA we should do it.

Q: We should find a method that allows the AP to handle the CFO with 1000ppm error when receiving the UL. Then it's not required for the AMP STA to calibrate.

Q: Slide 8. It should be implementation dependent to do CFO calibration on the DL signal.

A: Then the AP must be able to handle 1000ppm error.

C: Frequency synchronization is a challenge. Your simulations did not take into account the low capabilities of the AMP STA. Slide 6. OOK needs 10dB, so 1000ppm should be enough.

C: Similar as comments before. AP has wider bandwidth and ADC.

## Recess

The chair announced the session recessed at 12:20 EDT.

Next session will be on July 17th AM1.

# Wednesday AM1 (2024-07-17T08:00-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r4).

* Chair calls the meeting to order at 08:00 EDT.
* Chair instructs membersto record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the agenda for the meeting slot.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r04 (slide 25).

* Call meeting to order and remind the group to record attendance on imat.ieee.org
* IEEE-SA IPR policies and meeting rules
* Approval of agenda
* Contribution discussion
  + 11-24/1202, Scanning and discovery for AMP IoT, Weijie Xu (OPPO)
  + 11-24/1203, Authentication and Security transaction for AMP, Chuanfeng He, (OPPO)
  + 11-24/1242, AMP Security Transaction Methods Using Random MAC Address for Privacy, Hui Luo (Infineon Technologies)
  + 11-24/1215, Feasibility study on long range backscatter operation, Weilin (Huawei)
* Any other business?
* Recess

Chair calls for approval of the agenda of the TGbp session.

No discussion, no objection, agenda approved.

## Contributions

### Presentation of IEEE 802.11-24/1202r0, Scanning and discovery for AMP IoT, Weijie Xu (OPPO)

Q: Understand case with beacon, want to know more without beacon. What is RF ED?

A: RFID has no beacon. Reader query RFID devices, it can select a subset. Selected RFID devices randomly access the channel, with collision probability. For 802.11 collisions have to be avoided, as they affect the system efficiency. In addition, beacon helps with the power saving.

Q: Understand the motivation, but what is the assumption on the STA side? Is STA scanning? Is it a regular (20MHz) beacon?

A: We have discussed active and long-range backscatter device. For both the beacon is useful. It depends on the use case.

Q: But it may be related to the device type, for example a backscatter device will not wake up regularly on its own.

A: RF ED receiver can be applied to all device types (ED = Energy Detection).

Q: And the beacon is 20MHz?

A: No, it is narrowband. It is a new beacon.

Q: Previous contribution introduced two types of receivers (RF ED and Zero IF). What is the bandwidth of Zero IF?

A: Zero IF needs to have a baseband filter, receiver bandwidth is much narrower. 4MHz, 8MHz. Scanning procedure can be very complicated. Channels need to be searched one by one. Only feasible for devices where power is not so limited.

Q: So for different receivers we need different scanning/discovery methods?

A: Maybe. If we can restrict / predefine the channel scanning might be ok.

Q: Assume AMP beacon is a frame using the AMP DL PHY?

A: Yes.

Q: Do the AMP STAs have memory, to store information of the beacon?

A: Important question. The device should be able to maintain the information in the memory. Power consumption of memory is acceptable, it is very low.

C: We need to define classes of devices / device capabilities.

Q: AMP devices need to be configured in advance. Can be define a standard how to configure an AMP device, such that the AMP device can later find the AP quickly (e.g., by a preconfigured channel)?

A: Yes. But this is not flexible. We can also use the beacon.

Q: Then it would be good to use the standard beacon.

A: The beacon will be a new beacon, it will be a narrowband beacon.

Q: Slide 6. Is the trigger frame used instead of the beacon?

A: Yes. In this case, there's only one device. When the AP wants to communicate to the AMP device it will trigger it. Details of the trigger frame will be discussed.

Q: What is the difference between the trigger frame and the beacon? For harvesting devices do you consider they can go to low energy state for long times?

A: For the beacon case: the main function is to convey system information, provide timing reference / TSF. We still need a trigger frame for the UL transmission.

A: Device can go to a power saving state. Need to support memory retention. Does not need to receive anything. Only wakes up in a certain time window.

Q: Slide 5. Is the time sync a burden for the AMP STA?

A: Devices need to maintain timing / its clock in a power-saving way. Accuracy might be not so good.

Q: Backscatter devices need to support beacon?

A: No. They can be similar to RFID.

Q: Usage of the word "trigger frame" is difficult, as there's a 11ax trigger frame.

A: The trigger frame here is for the reservation of the medium and indication of the start of the UL.

### Presentation of IEEE 802.11-24/1203r0, Authentication and Security transaction for AMP, Chuanfeng He (OPPO)

Q: WPA2 equivalent is proposed, and then 4-way handshake. With this scheme, the regular STA as authenticator, a Message 4 is needed to confirm the PTK.

A: Procedure is like the baseline procedure. Authentication is via checking of the MIC in Massage 2.

C: Without M4 a man-in-the-middle attack is possible.

Q: Makes sense, like the reuse .11 methods. But reverting back to WPA2 needs to be discussed if that's sufficient. Slide 6. Where is the data part?

A: Focus on logistics use case. AMP STA are triggered to report their id to the regular STA.

Q: If the id is not known, how does it know that it has the specific shared key?

A: There's one logistic operator that pre-configures the shared key.

Q: Does all AMP STAs have the same shared key?

A: Yes. But following the procedure a different PTK.

Q: Assume a mixture of different device types (backscattering and active). Can there be a uniform procedure?

A: This submission is about the logistics use case. In other use cases strong security requirements can be assumed, solution can be different than solution 2.

### Presentation of IEEE 802.11-24/1242r0, AMP Security Transaction Methods Using Random MAC Address for Privacy, Hui Luo (Infineon Technologies)

Q: Slide 12. For certain capabilities 160B are needed, some only 32B. This is for the UL. On the DL is this similar? DL data rate might be even lower / more limited.

A: 2nd message size depends on the data payload. Minimum maybe 32B. MIC 32B for strong security. In total 160B with a small data payload. Remaining messages will be smaller.

Q: Have you done complexity analysis on the STA side? Also, for the hashing? Concerned on the load on the AMP STA side. Do all AMP STAs need to do the hashing?

A: Case on Slide 10, yes, all AMP STAs need to do the first step. Related to power consumption analysis based on Ascon given in referenced paper. Consumes 2 to 2.6µJ. Assume one message exchange per hour, smalles cell battery 25µA, will last for 1 year, based on data in 2020.

Q: Question was on SAE.

A: SAE elliptical curve algorithm, need to search for the reference.

Q: Concerned that SAE is the right approach. Especially with the privacy / random MAC address, which is affecting all AMP STAs. There could be AMP STAs that do not support hashing.

Chair announces that an additional session might be scheduled Wednesday PM2, depending on the availability.

## Recess

The chair announced the session recessed at 09:59 EDT.

Next session will be on July 17th PM2, given it is scheduled during the midweek plenary.

# Wednesday PM2 (2024-07-17T16:00-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r5).

* Chair calls the meeting to order at 16:00 EDT.
* Chair instructs membersto record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the agenda for the meeting slot.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r05 (slide 27).

* Call meeting to order and remind the group to record attendance on imat.ieee.org
* IEEE-SA IPR policies and meeting rules
* Approval of agenda
* Contribution discussion
  + 11-24/1215, Feasibility study on long range backscatter operation, Weilin (Huawei)
  + 11-24/1263, AMP Supported Legacy Mode, Pooria Pakrooh (Qualcomm)
  + 11-24/1208, Thoughts on the AMP WPT protocol, Ian Bajaj (Huawei)
  + 11-24/1253, Ultra Low Power Features For Active Devices, Amichai Sanderovich (Wiliot)
  + 11-24/1307, Proposed tgbp functional requirements, Bin Qian (Huawei)
* Any other business?
* Recess

Chair calls for approval of the agenda of the TGbp session.

Some discussion, slight change of the order of presentations (final order given above), no objection, agenda approved.

## Contributions

### Presentation of IEEE 802.11-24/1215r0, Feasibility study on long range backscatter operation, Weilin (Huawei)

Q: Is energy harvesting at the tag supported in the long-range backscatter case?

A: We're open to this.

C: Usually, energy harvesting is the bottleneck for the distance. Long-range backscatter might not make sense with energy harvesting.

Q: Regarding the link budget for the UL (Slide 6). Minimum rx power is -25dBm. Do you assume there is no storage?

A: There might be power storage.

C: In this case the minimum rx power can be further reduced, -30dBm might be ok. This further increases the distance between the carrier source and the tag.

Q: Slide 4. Is the carrier source on all time, transmitting continuously?

A: Here it's only about the link budget. We are open for different options. This is just high level.

Q: Slide 5. Minimum rx power for AMP tag is -45dBm. Is this the power or the communication signal?

A: Clarification, it is the receive sensitivity, not the minimum power to energize.

Q: Need clarification how the protocol can work for the energy harvesting case. What about coexistence with legacy device?

A: Agree, focus was only on the link distance.

Q: UL assumptions, minimum receive power -20dBm, AP receiver sensitivity -95dBm. Is this including assumptions for the noise floor? The carrier transmission will become noise for the AP receiver. Hence, there needs to be a margin for the SNR due to the carrier signal leaking to the AP receiver.

A: Agree, did not consider. Need more evaluations.

Q: Slide 5. -45dBm is absolute power for the reception? Can't we do much better because there's no carrier source? WUR OOK can do -82dBm. Where is -45dBm from?

A: -82dBm is far lower. -45dBm is from an earlier presentation.

### Presentation of IEEE 802.11-24/1263r0, AMP Supported Legacy Mode, Pooria Pakrooh (Qualcomm)

Q: Slide 3. Different Topologies. Seems like UL and DL use 11b/n. So – it just defines a Wake-Up Radio?

A: It needs a wake-up signal. The blue path sends data in the UL, response might be an ACK.

Q: What is the target, what are the "possible enhancements" for the standard range?

A: Lower the power consumption. Wake-up design may be improved further for the short range.

Q: Slide 4. What is the relay function?

A: To send the wake-up signal and receive the UL data, relay to the AP.

C: Don't think relay is in our target. Relay does not extend the range. There is no difference between this figure and the previous one.

Q: Slide 3. Where does the power for "blue line" communication come from?

A: Energy harvested from the S1G energy.

C: Doubt if this is sufficient for 11b/n.

Q: Slide 3. "Blue line" needs no change. WUR is already specified. So, in this mode there's no new protocol, current standard already supports this?

A: Yes, but there can be improvements.

Q: Slide 4. "Blue line" is existing protocol. Is there a (new) relay protocol, or are the links independent? Unclear what needs to be defined, given the SP.

Q: "Blue link" also has MAC protocol? Including association, discovery, etc.?

A: Yes.

Q: Why only define the DL?

A: The UL is out of the scope, it's using 11b/n as defined. The "DL" is the wake-up signal.

Q: Is the energizer associated with the AP, the AP can communicate directly with the energizer?

A: Yes, has to be.

Q: Can the energizer and the AP be co-located?

A: Yes.

Q: Wake-up is in 2.4GHz or 1GHz?

A: Currently 2.4GHz.

Q: Slide 3. If the AMP client is sleeping, how will the wake-up work?

A: It receives energy.

### Presentation of IEEE 802.11-24/1208r0, Thoughts on the AMP WPT protocol, Ian Bajaj (Huawei)

C: Slide 3. Mode 2, energizer is a non-AP STA? Communication between AP and energizer is on 2.4GHz? Suggest that communication may also be via wire, using another protocol?

Q: Slide 4. Assume AMP tag chooses the frequency band?

A: Mode 0 only has a static configuration. Mode 1 and 2 may be used to set some special parameters to enhance the energy harvesting.

Q: Not sure the WPT configuration is needed. Energy harvesting is different from communication, no timing, purley passive. Energy harvesting needs no configuration.

A: Mode 0 can always exist, ambient power energy harvesting (from any source, not only RF). Mode 1 is to improve energy harvesting.

Q: Slide 3. Mode 1 and 2 have a communication link. Is this AMP communication?

A: Yes.

Q: Mode 2, energizer could also be triggered by an AMP signal to keep the complexity low?

A: Yes.

Q: Slide 3. Harvesting of multiple AMP STAs can be from one energizer, with different distances and even mobility. This information becomes useless over time. Expectation to control the energizing / duty cycle might be too complicated.

A: Agree, energizing is broadcast. We have more details, wanted to keep it simple, details are in future contributions. First introduce the three modes, to have some groundwork.

C: Not sure if this is going into the right direction.

C: Not sure WPT "link" is the right word. Maybe also link AP — AMP STA is not required; control information can be decoupled.

C: Energizer is part of the infrastructure. Deployment needs to take care of the existence of the energizer.

C: Capabilities exchange AP-Energizer might not require something new. Existing standard already provides capabilities.

C on the procedure: SPs can be run at any time. It's up to the owner of the SP. At the moment, SPs are informative only, as there is no official TG document yet.

### Presentation of IEEE 802.11-24/1253, Ultra Low Power Features For Active Devices, Amichai Sanderovich (Wiliot)

Q: Do we need to run SPs if there is no TG document?

A: Yes, we want to understand the opinion of the group.

Q: Do you require a 1GHz radio for energy harvesting?

A: No, it's not a radio.

C: Support crystal-less architecture. Slide 7. DL needs to fit in 20MHz. UL power is not high power, e.g., -15dBm. Maybe we can loosen the requirements of the spectrum mask.

Q: Slide 3 & 5. Is it important that it is RF-harvesting for AMP-only? Only the passive / form factor is important.

A: RF harvesting should be enabled, it is the most demanding. Other types will be possible as well.

Q: Slide 7. FDM channels just current examples, channels will be narrowband?

A: Between 1MHz and 16MHz.

Q: SP2. Crystal-less device is an implementation-specific statement, should not be included in the standard.

A: It's more like a requirement.

Chair suggests sending in prepared SP text by eMail for the Thursday PM1 session.

## Recess

The chair announced the session recessed at 18:00 EDT.

Next session will be on July 18th AM1.

# Thursday AM1 (2024-07-17T08:00-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r5).

* Chair calls the meeting to order at 08:00 EDT.
* Chair instructs membersto record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the agenda for the meeting slot.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r05 (slide 29).

* Call meeting to order and remind the group to record attendance on imat.ieee.org
* IEEE-SA IPR policies and meeting rules
* Approval of agenda
* Contribution discussion
  + 11-24/1210, 802.11 Features Re-use, Vytas Kezys (HaiLa)
  + 11-24/1213, 2.4 GHz Downlink AMP PPDU Follow up, Bin Qian (Huawei)
  + 11-24/1212, Discussion on AMP Channel access, Rojan Chitrakar (Huawei)
  + 11-24/1236, Close-Range Backscattering Waveform and Modulation, Rui Cao (NXP)
* Any other business?
* Recess

Chair calls for approval of the agenda of the TGbp session.

Some discussion, switch of order, final order shown above. No objection, agenda approved.

## Contributions

### Presentation of IEEE 802.11-24/1210, 802.11 Features Re-use, Vytas Kezys (HaiLa)

Q: Slide 5. Reuse 11bc. What is the assumption on the AMP STA? Do they need to understand the legacy frames?

A: Yes, there are fields in the frames specific to 11bc. MAC addresses are replaced with service id; publish/subscribed mechanism.

Q: Not sure if this fits into the scenarios of AMP. Most use cases are unidirectional.

A: Some use cases a broadcast. Plus, overhead of association etc. might be too high, so broadcast / multicast might be better. In addition, architecture allows for relays and proxies.

C: Like to receive more details on 11bc, on how low-power AMP STAs implement legacy protocols.

Q: On the DSSS usage, no preamble is transmitted?

A: Backscatter frame will have the preamble. However, the legacy network does not have to support DSSS, only use for backscatter purpose.

Q: AMP STA shall support legacy protocol, like TWT and bc?

A: It's more on the AP side. Only slight changes to the protocol are needed.

C: On the waveform, DSSS. For active transmission the tag needs to change the phase, it's more complicated.

Q: DSSS, very inefficient spectral usage with wide bandwidth and low bitrate. Is this a misuse of the resources? Also, not applicable to active transmission.

A: 22MHz for 1Mb/s might be overkill, but large bandwidth is needed to compensate fading in multipath. Diversity gain needed.

### Presentation of IEEE 802.11-24/1213r1, 2.4 GHz Downlink AMP PPDU Follow up, Bin Qian (Huawei)

Q: Slide 6. Multiple modes for AMP DL?

A: No exact data rates, but we might consider a wider range than WUR.

Q: Exact parameters in the SIG field as given?

A: No, just parameters. PHY version id good to early stop decoding. Same for BSS color. Only initial thoughts.

Q: Maybe use U-SIG to support 3rd party STA?

A: Not excluded.

Q: Number of data rates. WUR has 2, with two different sync fields. If only one sync field exists, then for the high data rates the sync field might be too long. Also depends on the expected SNR. Integrated energizer might have high SNR (distance is limited on the energizing), otherwise very low SNR.

A: Yes, sync field needs to match the data rate requirement.

Q: Different sync field for high and low data rate. Will the receiver become more complex to support two sync fields?

A: Can use idea of WUR. Low data rate sync field just uses concatenated "W" to increase size.

Q: AMP PPDU for backscattering may look different?

A: Might be able to add symbols to the AMP DL PPDU to enable backscattering in the UL.

C: On the SPs. AMP has different applications: OOK, backscattering. Need to run high-level SP first to check how many PPDU types we need.

Q: AMP STA only decodes the narrowband part?

A: Yes.

Q: What kind of receiver is assumed for the narrowband part? E.g., UHF RFID does not require a preamble, or only a short one.

A: Did not touch the receiver design. RF envelope detector, RF IF receiver.

Q: Tags are low energy, so it should be able to stop reception early if it is not the receiver.

A: Agree.

### Presentation of IEEE 802.11-24/1212r0, Discussion on AMP Channel access, Rojan Chitrakar (Huawei)

Q: Close to what UHF-RFID is used.

A: Yes, in UHF-RFID in every slot a DL PPDU is used.

Q: Shall this be used for the inventory only?

A: Yes. This is the first communication with the devices.

Q: How many slots do you need for a typical application? It's also related to the timing accuracy.

A: Initial just a small number of slots, then increase.

Q: Similar to UHF-RFID, but no DL control frame. If there are many slots the latest one may have a large variation with the high ppm.

A: Yes, agree; maybe there can be a compromise.

Q: Also depends on the STA type, active or backscatter.

A: Yes, might be different for active devices, will bring a new contribution.

C: Good to use the name "AMP Poll" instead of trigger frame.

Q: Need to classify devices and their capabilities, both MAC and PHY. Some will not have memory, for example.

A: This is geared to lower-capability type. Need to see if one scheme fits all.

C: Number of slots is critical with relation to timining, may have more than one slot. First one is used by backscattering device, others by active devices.

C: Assume device is synchronized with the AMP Poll. Generates random number. What about stateless devices, which are limted to keep their memory. May need more TXOPs / sessions than it can preserve the memory.

C: Random access type depends on the device capability. For active devices we can use other methods. Also consider CDM.

C: There can be a filtering mechanism which devices can respond. In the RFID case the reader adapts the filter parameter to reduce collisions.

### Presentation of IEEE 802.11-24/1236, Close-Range Backscattering Waveform and Modulation, Rui Cao (NXP)

Q: Tricky to put a whole frame sequence into a PPDU? What is the duration?

A: Need to define PPDU types. Duration needs to be calculated. For single tag one PPDU is sufficient.

Q: PAR defines energy harvesting is in 1GHz.

A: Backscatter uses the same energy as received for the transmission.

Q: What is the energy source assumed for the tag? Charging needs several seconds.

A: Only energized by the PPDU. We showed in previous contribution that for ~10cm, charging less than 1ms is sufficient.

Q: Slide 9. Propose 3 DL PPDUs. What are the reference symbols, why are they missing?

A: Reference symbols for leakage removal. Next level of detail, they will be at the beginning.

Q: What is the advantage of FM0 / Miller encoding vs Manchester encoding?

A: Boundary of every symbol has an energy transistion.

Q: Why prefer 11b over OFDM?

A: From energy harvesting perspective similar performance, 11b has constant energy. Main consideration is on modulation itself. OFDM has spectrum challenges. Also chip-rate of 11b (11M/s) has higher flexibitly than OFDM (4µs symbol duration).

Q: Energizing in 2.4GHz. Maybe energize in sub-1GHz? UHF-RFID has sub-1GHz anyways.

A: Separate usecases. Mobile device would need to transmit in sub-1GHz.

Q: Energizing symbols will be used for backscattering. It's not pure DL.

A: Yes, need to discuss what kind of PPDUs are needed.

Q: Last slide. 11b: DSSS or CCK?

A: Yes, need to cite from the correct chapter.

Q: What is the bandwidth?

A: Same as energizing signal, 22MHz, DSSS.

Q: OFDM-like signals?

A: Only backscattering.

## Recess

The chair announced the session recessed at 10:00 EDT.

Next session will be on July 18th PM1.

# Thursday PM1 (2024-07-17T13:30-04)

## Opening

The TG Chair, Bo Son (Sanechips), presents the TG bp meeting agenda slides (IEEE 802.11-24/1066r6).

* Chair calls the meeting to order at 13:30 EDT.
* Chair instructs membersto record attendance in IMAT.
* Chair reviews the meeting rules and patent policy (slides 2-8).
* No response to the call for patents.
* Chair reviews IEEE-SA COPYRIGHT POLICY (slides 9-10)
* Chair reviews other Guidelines, Participation, Suggested Best Practices, and Registration (slides 11-14).
* Chair reviews the agenda for the meeting slot.

## Agenda

Chair presents the agenda of the session: https://mentor.ieee.org/802.11/dcn/24/11-24-1066r6 (slide 31).

* Call meeting to order and remind the group to record attendance on imat.ieee.org
* IEEE-SA IPR policies and meeting rules
* Approval of agenda
* Motion on selection procedure document (11-24/897r1)
* Functional Requirements baseline (11-25/1307r0) and motion
* Contribution SPs and Motions (with 5min for 11-24/1180r2 update)
* Contribution discussion
  + 11-24/1200, Follow up on Transmission Modes, Yinan Qi (OPPO)
  + 11-24/1213, 2.4 GHz Downlink AMP PPDU Follow up, Bin Qian (Huawei)
* Timeline review
* Teleconference plan
* Any other business?
* Adjourn

Chair calls for approval of the agenda of the TGbp session.

No discussion, no objection, agenda approved.

## Motion #2

Move to approve the TGbp selection procedure as defined in 11-24/0897r1.

Moved: Bo Sun

Seconded: Vyta Kezys

No discussion. Motion approved by unanimous consent.

## Functional requirements document (FRD) baseline

Bin Qian (Huawei) presents IEEE 802.11-24/1307r0, "Proposed 802.11bp Functional Requirements"

Q: Data communication, expect text about DL, UL, backscatter – so further items will be created?

A: This is correct, further subsections will be added if needed as functional requirements.

Q: Coexistence section. Mentions 802.11-2020, but we have a lot of (not yet integrated) ammendments.

A: Statement is copied from the PAR. However, once the next version of 802.11 is published, PAR might be updated.

Q: What about ammendments (e.g., bc)?

A: All ammendments after 2020 may be considered, but it is not in the PAR.

A: PAR should not refer to ammendments. Only freely available documents may be referenced.

C: FRD will be populated by whom?

A: Bin Qian as releaser of the initial version will maintain later versions.

C: Additions and removals require a passed technical motion (75% yes votes).

C: Published ammendments are part of the standard. In addition, the coexistence should consider major market PHYs like ax and be.

C: What does "deployed STAs" mean? Only available on the market? No STA on the market is 100% compliant to the standard.

Further discussion on the wording of requirement 3, as copied from the PAR.

Suggestion to add a note to R3: "The TGbp will revisit the coexistence with published and in-development 802.11 amendments".

## Motion #3

Move to approve the baseline of TGbp Function Requirements doc as included in 11-24/1307r1, for future development based on consensus

Moved: Bin Qian

Seconded: Bin Tian

No discussion. Motion approved by unanimous consent.

## Contribution SPs and Motions

SPs can be found in the agenda document, IEEE 802.11-24/1066r5, slide 32ff.

Presentation of IEEE 802.11-24/1189r2 by Solomon Trainin (Wiliot)

C: Suggest deferring the SP until we have an SFD.

C: Suggest only to run SP2 to start the architecture definition.

C: Simple devices may actually not have a stack. Also suggest deferring this SP.

**Author decides to defer the SP1 and SP2.**

SP3 based on 11-24/1215r1: Do you support that 11bp defines at least one mode of MAC/PHY that supports long-range backscattering communication in 2.4 GHz as shown below [see figure on slide 34].

C: Unclear what the "Carrier Source" means.

C: Suggestion to delete the figure and the "as shown below".

C: Suggestion to add "bi-static".

C: Suggestion to remove "long range".

SP3' based on 11-24/1215r1: Do you support that 11bp defines at least one mode of MAC/PHY that supports bi-static backscattering communication in 2.4GHz?

**No objection.**

SP4 based on 11-24/1194r0: Do you support that 11bp should support a mechanism that allows an AMP STA to report its device capability information.

Note: The detailed capability information is TBD.

C: Very general SP, every ammendment will define capability information.

C: Very early stages, no understanding of limitations of AMP devices. Too early for this SP.

C: "should" might not be the correct word, that means it is optional.

C: Might not apply to all cases.

C: Suggestion to remove "should".

SP4' based on 11-24/1194r0: Do you support that 11bp supports a mechanism that allows an AMP STA to report its device capability information. Note: The detailed capability information is TBD.

**13 Yes, 15 No, 8 Abstain**

SP5 based on 11-24/1208r1: Do you agree that 11bp shall support WPT Mode 0?

Mode 0 - WPT Receiver acts as a passive energy harvester.

C: PAR already says energy harvesting is supported. SP is redundant.

C: Suggest reformulating, not use "WPT" and "Mode 0"; use "passive energy harvester" instead.

C: Suggest deferring.

**Author defers SPs 5, 6 and 7.**

SP8 based on 11-24/1212r0: Do you agree that 802.11bp defines a time-based random access mechanism?

Note: Other random access mechanisms are not precluded.

C: MAC channel access needs more discussion.

**Author defers SP.**

SP9 based on 11-24/1263r0: Do you agree that 11bp supports a mode to enable AMP devices to operate in legacy WLAN network by defining AMP DL and required control/signaling?

**33 Yes, 2 No, 6 Abstrain**

## Contributions

### Presentation of IEEE 802.11-24/1200, Follow up on Transmission Modes, Yinan Qi (OPPO)

Q: Slide 5. What are legacy protocols?

A: For example, 11ba (OOK, Manchester encoding). Legacy MAC power management with enhancements.

Q: Slide 3 shows different modes, we need more discussion to structure the applications towards an architecture and then map MAC/PHY requirements to the architecture.

## Current Timeline

Chair reviews the current timeline.

Q: Suggestion to add milestones completion SFD and FRD.

A: There is an internal timeline timeline that contains these milestones.

## Teleconference Plan

Chair presents the plan for upcoming teleconferences:

* Aug 6 (Tuesday), 9:00am, ET, 2 hours; Webex
* Sep 3 (Tuesday), 10:00am, ET, 2 hours; Webex

Teleconference will take place if there is at least one submission to be presented.

## Adjourn

The chair announced the session adjourned at 15:26 EDT.

Next session will be the teleconference on August 6th.

Next hybrid (face to face & online) session will be the IEEE 802 wireless interim meeting starting from September 8th.