IEEE P802.11  
Wireless LANs

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| Minutes for 802.11 be MAC Ad-Hoc teleconferences in December 2019 and January 2020 | | | | |
| Date: 2019-12-12 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Jeongki Kim | LG Electornics |  |  | jeongki.kim@lge.com |
|  |  |  |  |  |

Abstract

This document contains the meeting minutes for the 3 TGbe MAC ad hoc teleconferences held in December 2019 and January 2020.

Revisions:

* Rev0: Added the telephone conference held the 12th of December 2019.

**Thursday 12 December 2019, 10:00 – 13:00 ET (TGbe MAC ad hoc)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:03. The Chair introduces himself and the Secretary, Jeongki Kim (LG Electronics)
2. The Chair goes through the 802 and 802.11 IPR policy and procedures and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reminds everyone to report their attendance by sending an e-mail to the Secretary and the Chairman himself. Based on the join.me app, it appears to be around 70 people in the call.  
     
   **Recorded attendance through the join.me app and/or reported attendance through e-mail:**
   * Akira Kishida (NTT)
   * AL Petrick
   * Albert Bredewoud
   * Alfred Asterjadhi (Qualcomm)
   * Abhishek Patil (Qualcomm)
   * BARON Stephane (Cannon)
   * Dibakar das
   * Dmitry Akhmetov
   * Gaurav Patwardhan
   * George Calcev
   * Hanseul Hong (Yonsei Univ.)
   * Insun Jang (LG)
   * Jane Erickson
   * Jason Yuchen Guo
   * Jeongki Kim (LG)
   * Jonathan Segev
   * Kazuto Yano (ATR)
   * Liwen Chu (NXP)
   * Matt Brooks
   * Ming GAN
   * Minyoung Park
   * Myeongjin Kim
   * Pascal Viger
   * Rojan Chitrakar
   * Sang Kim (LGE)
   * Sebastian Max (Ericsson)
   * Sharan Naribole
   * Stephane Baron (Canon)
   * Suhwook Kim
   * Sungjin Park (LGE)
   * Taewon Song
   * Younghoon Kwon,
   * Yongho Seok

1. The Chair reminds that the agenda can be found in 11-19/1720r0. Today we will go through submissions related to multi-link.

**Submissions**

1. **11-19/1528r2, Multi-Link Operation - Link Management (Abhishek Patil)**   
     
   **Summary:** R2 just updated the terminologies like MLD. Discussing the topic of link enablement. For AP power save, load balancing, co-ex conditions, need a mechanism for AP MLD to indicate the disablement of link(s). Two approaches, explicit signalling and implicit enablement (TID-to-Link maping).

**Discussion:**  
**C:** you had only a single association operation? After association, no way need to create or add the link,   
**A:** during association, MLD can negotiate the capabilities of multi-link? After association, you can enable or disable link.   
**C:** For adding/enabling/disabling a link, do you need new association or re-association?

**A:** enablement/disablement could be possible by multi-link setup procedure. Adding or creating link as well.

**C:** what is the disabled link?  
**C: disabled** link doesn’t allow any UL traffic or DL traffic. Beacon?

**A:** It will be in both links.

**C:** TID-to-Link mapping need a new signalling mechanism. In some case, we may define new power saving. Need to clarify that.

**A:** Existing power saving mechanism will be applied. Details will come later.  
**C:** link has only one STA. enablement means the operational?

A: If a link is enabled, the baselink power saving is used in the links.

C: For association, need link enablement/disablement?

A: Before association, any link could be used.

C: AP or non-AP can enable/disable the links?

A: It depends on the scenarios (who initiates it, what is the scenario?)

C: Explicit enablement/disablement is much clear to me.

A: TID-to-link mapping provides the clear operation. See both exmaples

1. **11-19/**[**1541r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1541-01-00be-performance-aspects-of-multi-link-operations-with-constraints.pptx)**-Performance aspects of multi link op with constraints (Dmitry Akhmetov)**   
     
   **Summary:** Multi-link device may need to impose constraints on concurrent TX/RX operations on different bands

Introducing 2 new modes of operation with restrictions

isolated (R)estricted MPC

Non-isolated (R)estricted MPC

AP is considered a “better” device and can operate under “isolated RMPC” while STA operates under “non-isolated RMPC” rules

* + For STAs without Tx/Rx constraints, MPC mode of operation performs very well
  + For STAs that have Tx/Rx constraints, both isolated and non isolated RMPC mode of operations preform much better than fully synchronized access
  + Even with Tx/Rx constraints, MLLE still can provide benefits in terms of reduced latency

**Discussion:**

**C: page 6, right figure, OBSS load is zero?** why is the red bar reduced?  
**A:**   
**C:** In Your simulation, only DL, no OBSS. A single BSS. Then, no block the channel.

**C:** Why happened when one link is occupied, other links are idle?

**A:** links are independent…..  
**C: two back-offs on two link? not fair independent channel access.**

**A:** multiple primary channel… Perfomance of synchronous operation depends on the environments  
**C:** Slide 4, you list channel access rule. Non-isolated RMPC.

**A:**

**C:** For isolated RMPC, how do you differentiate isolated RMPC from MPC, for interference level, etc.?

1. **11-19/**[**1544r0**](https://mentor.ieee.org/802.11/dcn/19/11-19-1544-00-00be-multi-link-power-save-operation.pptx)**-Multi-link power save operation (Minyoung Park)**  
   **Summary:**

**Per-link power save operation**

**propose to use the power states of a STA per-link to indicate whether the enabled link isavailable for frame exchange**

When a STA is in the awake state, the link is available for frame exchange

When a STA is in the doze state, the link is not available for frame exchange

There may be other conditions that need to be met for frame exchange

**Concurrent multi-link case: non-AP MLLE signals in a frame the awake/doze states of multiple STAs to the AP MLLE**

Jarkko, Xiaofei, Insun,   
**Discussion:**  
**C:** Agree that we need to define the power efficiency mechanism, simplifying, co-existence etc. TIM element can not be used for all power saving mechanisms.   
**A:** It’s hard to explain because I didn’t prepare the diagrams about that. Some of details can be shared offline.

**C:** one link can indicate the power states of other links.

**A:** I agree with it. We need more discussion.  
**C:** do you have any performance for TID-to-link mapping? I’m not sure it improves WLAN.

**A:** Not yet. How useful TID mapping will be handled by other people. We just consider that assumption.   
**C:** slide 7, do you consider the dedicated link? Control channel?

**A:** Singaling should be dedicated link or any link? Now any link. We don’t consider it yet. We need more details

1. **11-19/**[**1546r0**](https://mentor.ieee.org/802.11/dcn/19/11-19-1546-00-00be-legacy-performance-impact-on-multi-link-operation.pptx)**-Legacy Performance Impact on Multi-link Operation (Yongho Seok)**  
     
   **Summary:** **Performance evaluation per each MLO types**

**The MLO-MPC does not have any impact on the performance of legacy STA.**

**But, when the MLLE has a constraint on simultaneous Tx and Rx, both the CMLO-SPC and CMLO-MPC have some throughput loss and instead the legacy STA is taking more throughput gain.**

But, it seems that allowing the multiple primary channels shows the best operation mode for both the legacy STA and the EHT STA. That is, no performance degradation of legacy STAs

**Discussion:**

**C:** slide 15, for single primary channel, BSS2, the performance of legacy STAs is increased. (STA 6, 7, 8, perSTA throughput). What is reason? In this case, single primary channel? Throughput is much higher.  
**A:** STA4 and 5 are reference simulation model. In link 1, STA a is access the channel based on ED. In link2, 7 STAs accesses the channel based on EDCA. So, STA6, 7, 8 have higher throughput.  
**C:** in simultation, each STA has 80+80. Each link is 80MHz. in slide 14 (MPC+), multi-link device (80+80) is same as legacy STAs (80 +80) do you have consideration like this?

**A:** almost same. Link 1 is 80+80. Link 2 is 80+80. Different consideration? Legacy performance issues. I didn’t attach. Results are almost same.  
**C:**slide 9, this is not actual frame exchange?

**A:** STA performs the EDCA channel access. Start time can be different. TX/RX time is different time. If you look at the result, MLO-MPC and CMLO-MPC is different

1. **11-19/** [**1548r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1548-00-00be-channel-access-design-for-synchronized-multi-links.pptx)**-Channel access design for synchronized multi-links (Yunbo Li)   
   Summary:**.  
   TXOP setup procedure for multi-links

**Younghoon, pooya, insun, abhi, Dimitry, Jarrko**  
**Discussion:**

**C: what happen if** link 2 is transmitted from legacy STA  
**A:** It’s bigger issue. I don’t have solution for it.  
**C: slide 8,** in link2, how can MLD 2 know the duration of BA of link 1(e.g., ba, ack, M-ba,)?

**A:** the STA doesn’t need to know the length exact duration. It’s organized by AP. AP can handle it.  
**C: Block Ack is longer than normal ack**

**A:** we need think more. I prefer the single primary channel mechanism to avoid complex issue.  
**C:** slide 8. Wasting the spectrum airtime in link 2. Depending on traffic pattern. obviously How can it expect the spectrum size based on traffic pattern?

**A:** I agree. I don’t prefer this solution.

**C:** Same comment as younghoon. Conern on supporting the single link legacy STA. Not easy to control the STAs. Solution for Synchronous AP/non-AP MLD are fine

**A:** I agree

**C:** non-AP MLD2. How legacy STA detects the preambles?

A: If MLD2 missed the preamble of PPDU1, it may happen. And if it may happen, there is some issue in AP side.

C: slide 8, duration of Ack is different from duration of BA.

A: AP side is also synchronous ML.

C: If STAs are hidden, synchronous ML AP could not receive frames.

C: slide 5. How can the STA maintain NAVs for both primary channels?

A: STA need to keep NAV for both links.

**Adjourned at 12:57 ET.**

**Thursday 17 October 2019, 07:30 – 10:00 ET**

**Introduction**

1. The Chair (Alfred Asterjadhi, Qualcomm) calls the meeting to order at 07:33. The Chair introduces himself and the acting Secretary and vice chair, Matthew Fischer (Broadcom)
2. The Chair reminds the attendees that the agenda can be found in 11-19/1720r1. The agenda for today includes submissions related to joint transmission and other topics.
3. The Chair reviewed the 802 and 802.11 IPR policy and procedures and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
4. The Chair reminds attendees to note their attendance, by sending an e-mail to the Secretary. Based on the join.me app, there are 112 dialed lines, some of which might represent multiple participants.  
     
   **Recorded attendance through e-mail:**
   * Alfred Asterjadhi (Qualcomm)
   * Cheng Chen (Intel)
   * David Lopze Perez (Nokia)
   * Dmitry Akhmetov (Intel)
   * Jarkko Kneckt (Apple)
   * Kazuto Yano (ATR)
   * Lily Yunping Lyu (Huawei)
   * Liwen Chu (Marvell)
   * Matthew Fischer (Broadcom)
   * Ron Porat (Broadcom)
   * Sharan Naribole (Samsung)
   * Steve Shellhammer (Qualcomm)
   * Yongho Seok (Mediatek)
5. Chair asks for any announcements – none from the attendees, but the chair announces that a session slot for Tuesday PM3 of the November 2019 meeting is available and that he will ask for that slot for TGbe and send an updated schedule
6. The Chair asks if there is any objection to continue with the agenda with the submission in the listed order. Nobody speaks up, agenda approved.

**Submissions**

1. **11-19-1594-02-00be-coordinated-beamforming-null-steering-protocol-in-802-11be – David Lopez-Perez (Nokia)**  
     
   **Summary:** The authors review the major joint transmission/reception challenges, put forward coordinated beamforming/null steering as an appealing inter-AP coordination scheme, and sketch a protocol to efficiently realize the coordinated beamforming/null steering gains.  
     
   **Discussion:**  
   C: Slide 12 - Is null steering used for UL?  
   R: There is UL-UL scheduling.  
   C: so this is BF?  
   R: N, there are receive filters for UL at the AP  
   C: So the CSI is for DL  
   R: Y  
   C: slide 12 – trigger frames are not aligned, using SR parameters, for ACK, there is alignment, why different?  
   R: Null steering used for ACK transmissions by the APs, also could use for TFrame, could also use contention based, UL based  
   C: slide 7 – how does AP2 know which STAs to include for SR?  
   R: AP2 can use previous TX results to determine if interference is present and that SR could be beneficial  
   C: slide 9 – why AP1 has to receive FB from donnee AP2  
   R: so that AP1 can create a null  
   C: slide 12 – UL use case, AP2 TF is ok because of null with AP1, and why UL case?  
   R: yes – because of null, can do SR in any case, just started with UL because SR parameters are available in that case  
   C: receive nulls are shown, can you determine these through sounding FB?  
   R: N, for UL, through preamble, assuming you have spare atennnas  
   C: slide 12 – is AP2 TF using anything other than ordinary channel sensing?  
   R: no
2. **11-19-1595-00-00be-consideration-on-joint-transmission - Lily Yunping Lyu (Huawei Technologies Co. Ltd.))**  
     
   **Summary:** The authors suggest that the gain of JT is very attractive, while on the other hand, JT has stringent requirements. Following challenges have been mentioned in TGbe till now: Heavy load on backhaul and Stringent synchronization requirement. In this presentation, we analyze the feasibility to exploit JT in scenarios with wired backhaul, such as enterprise market, and some residential markets.  
     
   **Discussion:**  
   C: the scenarios indicated are cases that should be considered as valuable applications of JT and therefore, justify the inclusion of JT in TGbe  
   R: agree  
   C: slide 5 –architecture question, do these switches and coordinators need to be included in 802.11?  
   R: no, but if we allow a non-wired backhaul case, then we might need to include something in the 11be amendment  
   C: will JT be effective in a home scenario?  
   R: yes, for example, in China, each room has a port, so that a wired backhaul is possible  
   C: which AP will be the one with the coordinator and switch?  
   R: one of them  
   C: wireless backhaul should also be considered/included in TGbe scope of work for JT  
   R: agree, some scenarios might not have access to a wired backhaul  
   C: slide 7 – 300 Hz number – can you do better  
   R: this is from a paper – in our own results, we can do better
3. **11-19-1597-00-00be-jt-performance-with-multiple-impairments - Ron Porat (Broadcom)  
     
   Summary:** The authors update their JT results from [11-19-0799-01-00be-comparison-of-cbf-and-jt] (simulation configuration r1) to include the impact of additional impairments.  
     
   **Discussion:**  
   C: slide 3 – power difference is due to what?  
   R: between sounding and JT, slave and master powers might drift  
   C: other impairment numbers depend on estimation and SNR, right?  
   R: yes, but JT is better suited for higher SNR, so 0.5 ns seems ok, CFO depends on SNR as well and we think that the number used is ok for the case when JT is applicable  
   C: phase drift accumulates  
   R: worst case only for the entire reception applied to every symbol, reality will be better because we agree that it starts lower and then grows  
   C: residual CFO should be 20 Hz because it is +/-10 Hz  
   R: we assume a fixed 10 Hz, but yes, we assign each AP from a range of -4 degrees to +4 degrees  
   C: so that is +/- 10 Hz – did you apply residual CFO to both sounding and data?  
   R: no errors applied to sounding  
   C: would like to see the CFO applied to the sounding as well  
   R: we model errors on the SNR in the sounding, but not phase error, because the sounding is so short it will be a very tiny error  
   C: yes, but small errors are important in the sounding because they are multiplicative because they are the measurement frame – maybe 64 usec of duration  
   C: we simulated sounding phase error and it does have an impact on channel estimation error, but do not know the impact on JT  
   C: slide 4 first bullet v slide 3 first bullet – what is the difference?  
   R: phase error of channel estimation vs relative error between APs
4. **11-19-1616-01-00be-multi-ap-group-formation – Cheng Chen (Intel)  
     
   Summary:** Most EHT Multi-AP contributions so far have primarily focused on how to leverage the coordination within a Multi-AP group, assuming some APs act as Triggering APs and others serve as Triggered APs. In this presentation we study the fundamental framework of Multi-AP operations, i.e., the formation of a group of APs for various Multi-AP coordination functions. We focus on the management/control role of one AP among a group of APs that participate in Multi-AP coordination functions. We do not consider the sequence-trigger roles, i.e., who can send Multi-AP trigger frames etc. We will call the set of these APs as an EHT Multi-AP group. For simplicity, we use terminologies of the Coordinator AP and Coordinated APs in the management domain to differentiate it from the Master AP and Slave APs used in the domain of specific trigger operations as in most previous presentations  
     
   **Discussion:**  
   C: what is the role of the coordinator wrt group formation?  
   R: management and control  
   C: example?  
   R: long term scheduling coordination  
   C: master and slave are different from coordinator and coordinated?  
   R: yes, coordinator can define which AP can be a master and which are its slaves  
   C: coordinator/coorindated signalling wireless or wired?  
   R: no restriction  
   C: coorindator function can be in the wired DS which is not in the scope of 802.11  
   R: not saying that we have to define the coorindator functions as part of 802.11  
   C: but it could be either way – coordinator is present on 802.11 network or in wired, so I don’t know what you would include in 802.11  
   R: hooks to allow communication  
   C: group formation is good, I agree, slide 2 – if implementation specific then how do different vendors form a group?  
   R: user can decide how to assign coordinator function  
   C: coordinator to coordinated through wire or wireless?  
   R: no restriction  
   C: multi-AP has more than one joint TX mechanism, can this group be used for all of those mechanisms?  
   R: not discussed yet, but we could support that  
   C: JT could be dynamically coordinated without any group formation, except adhoc per TXOP
5. **11-19-1159-01-00be-multilink-operation-capability-announcement – Liwen Chu (Marvell)  
     
   Summary:** The capability to use multiple links by a multi-link logical entity should be announced. Whether a multi-link logical entity can do transmission while reception in more than one link  
     
   **Discussion:**  
   C: Audio problems occurred with presenter, so that the presentation was deferred
6. **11-19-1231-03-00be-multiband-and-multichannel-operation-in-ieee-802-11be –** Sai Shankar **(Cypress)  
     
   Summary:** New ways of operating in bands Efficient use of spectrum Leveraging underutilized spectrum Increased data rates Network load balancing Dynamic fast switching between bands/channels  
     
   **Discussion:**  
   C: the presenter was not present on the call, so the presentation was deferred
7. **11-19-1291-03-00be-performance-aspects-of-multi-link-operations –** Dmitry Akhmetov (Intel) **Summary:** An examination of the relative performance of three methods of multiple link medium access. SPC: Single Primary Channel with a PIFS medium condition check on the non primary to decide whether to transmit on the non-primary. MPC: Multiple Primary Channel and independent transmit and receive on the links. JMPC: Join Multiple Primary Channel, first backoff wins, with PIFS medium examination to decide whether to transmit on the other link.  
     
   **Discussion:**  
   C: slide 9 – the reported throughput for SPC vs the probability of two link access do not match up, using the 15% probability, the throughput should be 345 Mbps, not 600 Mbps  
   R: the network is not fully loaded, so all traffic can be delivered eventually, even though two links are active during only 15% of all TXOPs and 1 link active for 85% of all TXOPs

**Concluding remarks**

1. Any other business. Nobody speaks up.

**Adjourned**

**Thursday 31 October 2019, 10:00 – 12:30 ET**

**Introduction**

1. The Chair (Alfred Asterjadhi, Qualcomm), calls meeting to order. The Chair introduces himself and the Secretary, Dennis Sundman (Ericsson).
2. The Chair asks if anyone is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reminds about attendance, send an e-mail to the Secretary. Based on the join.me app, it appears to be around 80 people in the call.  
     
   **Recorded attendance through the join.me app and/or reported attendance through e-mail:**
   * Abhishek Patil
   * Al Petrick
   * Albert Bredewoud
   * Alfred Asterjadhi (Qualcomm)
   * David Kloper (Cisco)
   * Dennis Sundman (Ericsson)
   * Dongguk Lim
   * Insun Jang (LGE)
   * Jarkko Kneckt (Apple)
   * Jason Yuchen Guo
   * Jinmin Kim (LGE)
   * Jinsoo Choi
   * Joseph Levy (InterDigital)
   * Junghoon Suh (Huawei)
   * Kazuto Yano (ATR)
   * Ley Wang
   * Liwen Chu
   * Mark Hamilton (Ruckus/CommScope)
   * Miguel Lopez (Ericsson)
   * Ming Gan (Huawei)
   * Namyeong Kim
   * Rojan Chitrakar (Panasonic)
   * Ruy Yang (InterDigital)
   * Sang Kim (LGE)
   * Sebastian Max (Ericsson)
   * Sharan Naribole (Samsung)
   * Srinivas Kandala
   * Steve Shellhammer (Qualcomm)
   * Taewon Song
   * Yan Xin
   * Yonggang Fang
   * Yongsu Gwak
   * Young Hoon Kwon (Marvell)
   * Yunbo Li
4. The Chair asks if there are any announcements. Nobody speaks up.

**Submissions**

1. **11-19/1405r1, “Multi-Link Channel Access Discussion – Sharan Naribole (Samsung)**  
   **Summary:** The authors study a multi-link simultaneous transmit and receive (STR) mechanism. They believe that the AP shall support STR, but the STAs may not support STR. The authors also discuss how backoffs may work unduer the multi-link setup: STR capable devices may have several backoffs running simultaneously on multiple links, but when receiving on one link, the other links pause their backoffs.  
     
   **Discussion:**C: If an AP is receiving from one STA, can it transmit to another STA on the other link?  
   A: Yes.  
   C: If there is a preamble on two links at the same time. Which one is the STR/non-STR STA receiving?  
   A: We are not considering multiple receiving links at this stage, but in principle you can receive both.  
   C: Slide 9, I think there may be an issue for multiple STAs that miss the preamble.  
   A: This can happen.  
   C: I believe it is reasonable that some APs are not STR.  
   A: Thanks for the comment. Let’s have offline discussion.  
   C: Slide 7, why should non-STR STA stop countdown?  
   A: Because packet on the other link may be to the non-STR STA.  
   C: Does the STAs countdown at ch B take into account OBSS/basic NAV on that channel?  
   A: Yes. This is all on top of these procedures.
2. **11-19/1505r1, “Multi-link TXOP Aggregation Considerations” – Sharan Naribole (Samsung)  
     
   Summary:** The authors propose to enable simultaneous multi-link TXOP reservation. The link in which the BO counter reaches 0 first dictates when channels on the aggregated links are accessed.  
     
   **Discussion:**  
   C: Slide 6. I am concerned with the fairness. There can be a single link STA also on link B. What happens then?  
   A: This should be dynamic.  
   C: Whomever has a secondary channel as their primary, already today we have a fairness issue. What is the difference here?  
   A: We have multiple-primary channel scenario here.  
   C: Slide 5 for example. It seems you can use one link to get unfair BO advantage on another link.  
   A: Yes, this can happen in principle.
3. **11-19/1509r1, “Discussion on Multi-link Setup” – Insun Jang (LGE)**  
   **Summary:** The authors discuss how to signal multi-link capabilities: what information should go where. They also provide an example of ML setup procedure.  
     
   **Discussion:**  
   C: We need to advertise this information somehow. In your setup procedure on slide 10, are you following the convention that the non-AP STA initiates the procedure or can the AP do it?  
   A: Both non-AP STA and AP STA may do that.
4. **11-19/1512r1, “Multi-Link Acknowledgment” – Rojan Chitrakar (Panasonic)**  
     
   **Summary:** The authors discuss how block ACK (BA) should work in multi-link. They propose that a single multi-link BA agreement is setup between two multi-link entities.  
     
   **Discussion:**  
   C: Is the BA agreement per link or for multiple-link.  
   A: For the setup I assume we can use a single setup.  
   C: We should try to minimize the number of new terms.  
   A: I am open to that.

**Concluding remarks**

1. The Chair asks if there is any other business. Notbody speaks up.
2. The Chair mentions that the next telephone conference meeting is to be held November 7th.

**Adjourned**

**Thursday 7 November 2019, 07:30 – 10:00 ET**

**Introduction**

1. At 7:31 The Chair, Alfred Asterjadhi (Qualcomm), calls the meeting to order. The agenda document will be 11-19/1720r4.
2. The Chair informs about the IPR policy and procedure and asks if there is anyone aware of any potentially essential patents. Nobody speaks up.
3. The Chair reminds to record attendance by sending an e-mail to the Secretary, Dennis Sundman (Ericsson). Based on the join.me app there appears to be around 100 participants in the call.

**Recorded attendance through the join.me app and/or reported attendance through e-mail:**

* Alfred Asterjadhi (Qualcomm)
* Bo Sun
* David Kloper
* Dennis Sundman (Ericsson)
* Dongguk Lim
* Gaurav Patwardhan (HPE)
* Jason Yuchen Guo
* Jinmin Kim
* Kazuto Yano (ATR)
* Kazuto Yano (ATR)
* Lei Huang
* Liwen Chu
* Ming Gan (Huawei)
* Namyeong Kim
* Rojan Chitrakar (Panasonic)
* Ross Yu
* Ruy Yang (InterDigital)
* Ryuichi Hirata (Sony)
* Sai Nandagopalan (Cypress)
* Sang Kim (LGE)
* Sharan Naribole (Samsung)
* Sigurd Schelstraete (Quantenna)
* Srinivas Kandala
* Taewon Song
* Tomo Adachi
* William Carney (Sony)
* Yan Xin
* Yonggang Fang
* Yongho Seok
* Yongsu Gwak
* Yusuke Tanaka (Sony)

1. The Chair asks about any announcements. Nobody speaks up.
   1. The Chair informs that another time-slot for the upcoming F2F has been requested on Monday evening.
   2. The first session joint session for the F2F is the PM1 on Monday. But there will be ad-hocs in the Monday morning, AM1, in parallel sessions. In the morning ad-hoc technical submissions will be presented.
2. The Chair asks if there is any objection to proceed with the agenda with technical submissions. Nobody speaks up.

**Submissions**

1. [**11-19/1159r2**](https://mentor.ieee.org/802.11/dcn/19/11-19-1159-02-00be-multilink-operation-capability-announcement.pptx)**, “Multilink operation capability announcement” – Liwen Chu (Marvell)**  
   **Summary:** The authors have identified methods to announce multi-link capability on multiple links.  
     
   **Discussion:**  
   C: Slide 4. In the second bullet you mention that when the frequency distance between the two links becomes smaller simultaneous transmission and reception is not possible, but is this really true?   
   A: It can be.  
   C: Slide 3. To support transmission and reception concurrently on both links, you don’t need to announce that. Even if they are on the same band, they can transmit and receive at the same time.  
   A: This depends on the device capability. Some devices may be able to support that, others may require the multiple links to be on different bands.  
   C: Do you believe we need to consider transmission power when we consider the simultaneous transmit and receive capability?  
   A: We cannot say that now.
2. [**11-19/1231r3**](https://mentor.ieee.org/802.11/dcn/19/11-19-1231-03-00be-multiband-and-multichannel-operation-in-ieee-802-11be.pptx)**, “Multi-Band Multi-Channel Concept in IEEE 802.11be – A Simple Study” – Sai Nandagopalan (Cypress)  
     
   Summary:** The authors try to figure out what we really need to introduce in order to support the multi-link operations that have been discussed in EHT. The authors conclude that multiband architecture in revmd is sufficiently general and allows scope for any new innovation to support 11be multi-link or carrier aggregation capabilities.  
     
   **Discussion:**  
   C: Slide 21, what you say in bullet 4, does it mean that we have no work to do in .11be?A: No, what I am saying is that we may not need to change the architecture to enable the multi-link ideas suggested in the group.  
   C: I don’t understand what you are aiming at. On the one side you say that fast session tranfer (FST) can do anything, but when you start looking at details, many things are missing. For example power saving, simultaneous transmission, etc. We still need to define and create architecture for these ideas.  
   A: I am not against introducing new ideas, what I am aiming at are the architecture figures. I believe we may not need to change these figures.
3. [**11-19/1510r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1510-01-00be-eht-power-saving-considering-multi-link.pptx)**, “EHT Power saving considering multi-link” – Jeongki Kim (LGE)****Summary:** The authors propose enhanced power saving mechanisms for the multi-link concept by considering: OM Control, TWT operation, Intra-BSS PPDU Power save.  
     
   **Discussion:**  
   C: Slide10. This scenario is primarily to address the hidden node issue.   
   A: Thanks for your comment.  
   C: Slide8. Power save by the doze state doesen’t provide much power save. One would like to go completely to sleep.  
   A: Ok, thank you for the comment.
4. [**11-19/1525r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1525-01-00be-multi-link-association.pptx)**, “Multi-Link Association” – Abhishek Patil (Qualcomm)  
     
   Summary:** The authors propose thatAPs beacon advertises capabilities and operational parameters of all the links that AP entity operates on. Non-AP entity provides its capabilities information during probing and association. Both entities exchange capabilities and operations parameters during multi-link association. **Discussion:**  
   C: Slide 6. The probe request gives away quite some information there.  
   A: Even today you can do this, we only need to add multi link information.  
   C: Slide 7. Does the authentication takes place on the primary link. The primary link is the main link where to exchange the information.  
   C: With multi-link association you mean multi-link setup?  
   A: Yes.  
   C: Slide 7. I believe the security is a different negotiation than the multi-link association.  
   A: We can discuss this. The way I thought was that you establish the security key at the time of association.  
   C: It is a separate procedure.  
   A: Ok.

**Concluding remarks**

1. Any other business
   1. The submissions not yet presented are going to be presented in the F2F.
   2. The straw polls from the telcos will be run first thing when that topic is addressed in the F2F.

**Adjourned**