IEEE P802.11  
Wireless LANs

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| Minutes for TGbe MAC Ad-Hoc teleconferences in March and May 2020 | | | | |
| Date: 2020-03-13 | | | | |
| Author(s): | | | | |
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| Liwen Chu | NXP |  |  |  |
|  |  |  |  |  |

Abstract

This document contains the meeting minutes for the TGbe MAC ad hoc teleconferences held in March 2020 and May 2020.

Revisions:

* Rev0: Added the minutes from the telephone conferences held on March 16, 18 and 23, 2020.
* Rev1: Added the minutes from the telephone conferences held on March 26, 2020.
* Rev2: Added the minutes from the telephone conferences held on March 30, 2020 and some texts (day, attendance) are clarified.
* Rev3: Added the minutes from the telephone conferences held on April 6, 2020.
* Rev4: Added the minutes from the telephone conferences held on April 9, 2020.
* Rev5: Added the minutes from the telephone conferences held on April 13, 2020.
* Rev6: Added the minutes from the telephone conferences held on April 17, 2020.
* Rev7: Added the minutes from the telephone conferences held on April 20, 2020.
* Rev8: Added the minutes from the telephone conferences held on April 23, 2020 with some clarified texts
* Rev9: Added the minutes from the telephone conferences held on April 24, 2020
* Rev10: Added the minutes from the telephone conferences held on April 27, 2020
* Rev11: Added the minutes from the telephone conferences held on May 4, 2020

**Monday 16 March 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:04 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to modify their information in the webex application with name and affiliation and if cannot change them, send an e-mail to the secretary and the chairman.
4. The Chair reminds everyone to report their attendance by sending an e-mail to the Secretary and the Chairman himself. The webex app indicates about 86 people on the call.  
     
   **Recorded attendance through the webex app and/or reported attendance through e-mail:**
   * **YELLOW names are not yet confirmed**
   * Abhishek Patil (Qualcomm)
   * Akira Kishida (NTT)
   * Alan Zelenznikar (??)
   * Alfred Asterjadhi (Qualcomm)
   * Baokun Dig (??)
   * Carl Kain (??)
   * Cheng Chen (Intel)
   * Chunyu Hu (Facebook)
   * Dave Cavalcanti (Intel?)
   * Dibakar Das (Intel)
   * Dmitry Akhmetov (Intel)
   * Duncan Ho (Qualcomm)
   * Edward Au (Huawei)
   * Gabor Bajko (Mediatek)
   * Gaurav Patwardhan (Hewlett Packard Enterprises)
   * Geonjung Ko (WILUS Inc)
   * George Cherian (Qualcomm)
   * Guogang Huang (Huawei)
   * Guoqing Li (Apple)
   * H (in webex)
   * Harry Bims ???? (Bims Laboratories) – “harry” on list
   * Hedayat, Reza (Charter Communications)
   * Huizhao Wang (On, Qunatenna)
   * Insun Jang (LGE)
   * James Yee (Mediatek)
   * Jarkko Knecht (Apple)
   * Jason Yuchen Guo (Huawei)
   * Jeongki Kim (LGE)
   * Jinjing Jiang (Apple)
   * John Sun (WILUS)
   * John Yi (?????) – no affiliation
   * Jonas Sedin (Ericsson)
   * Jonghun Han (Samsung)
   * Joseph Levy (InterDigital)
   * Kazuto Yano (ATR)
   * Laurent Cariou (Intel)
   * Lei Wang (Futurewei)
   * Liangxiao Xin (Sony)
   * Li-Hsiang Sun (InterDigital)
   * Liwen Chu (NXP)
   * Li Yiqing (Huawei)
   * Liuming Lu (ZTE)
   * Mark Rison (Samsung)
   * Massinissa Lalam (Sagecom)
   * Matthew Fischer (Broadcom)
   * Ming Gan (Huawei)
   * Minyoung Park (Intel)
   * Mitsuyoshi Yukawa (Canon)
   * NaMyeong Kim (LGE)
   * Noel Stott (??)
   * Oren Kedem (??)
   * Osama Aboul-Magd (Huawei)
   * Patrice Nezou (Canon)
   * Po-kai Huang (Intel)
   * Pooya Monajemi (Cisco)
   * QG(??)
   * Rojan Chitrakar (Panasonic)
   * Ronny Yongho Kim (KNUT)
   * Sai (Cypress)
   * Sang Kim (LGE)
   * Sharan Naribole (Samsung)
   * Shubhodeep Ahikari (Broadcom)
   * Sindhu Verma (Broadcom)
   * Srinivas Kandala (Samsung)
   * Stephane Baron (Canon)
   * Subir Das (Perspecta Labs)
   * Sungjin Park (LGE)
   * Taewon Song (LGE)
   * Tomo Adachi (Toshiba)
   * Viger Pascal (Canon)
   * Xiaofei (Inter digital)
   * Yifan Zhou (Huawei)
   * Yong Liu (Apple)
   * Yonggang Fang (ZTE)
   * Yongho Seok (MediaTek)
   * Yongsu Gwak (KNUT)
   * Young Hoon Kwon (NXP)
   * Yunbo Li (Huawei)
   * Yusuke Tanaka (Sony)
   * Zhou Lan (Broadcom)

1. The Chair reminds that the agenda can be found in 11-20/425r2. Today we will go through submissions related to multi-link.

* Technical Submissions:
  + [1822r4](https://mentor.ieee.org/802.11/dcn/19/11-19-1822-04-00be-multi-link-security-consideration.pptx)–Multi-link security consideration (Po-Kai Huang) [1 SP]
  + [1963r1](https://mentor.ieee.org/802.11/dcn/19/11-19-1963-01-00be-multi-link-security-and-aggregation-operations.pptx)–Multi-Link Security And Aggregation Operations (Huizhao Wang)
  + [0054r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0054-00-00be-mld-mac-address-and-wm-address.pptx)–MLD MAC address and WM address (Po-Kai Huang)
  + [0063r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0063-00-00be-sta-mld-link-address.pptx)–STA MLD link address (Liwen Chu)
  + [1604r1](https://mentor.ieee.org/802.11/dcn/19/11-19-1604-01-00be-eht-direct-link-transmission.pptx)–EHT Direct Link Transmission (Dibakar Das)
  + [2125r0](https://mentor.ieee.org/802.11/dcn/19/11-19-2125-00-00be-eht-rts-and-cts-procedure.pptx)–EHT RTS and CTS procedure (Yongho Seok)
  + [0006r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0006-00-00be-proposed-corrections-to-channel-access-issues-in-802-11.pptx)–Proposed Corrections to Channel Access Issues in 802.11 (Shubhodeep Adhikari)
  + [0062r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0062-00-00be-protection-with-more-than-160mhz-ppdu-and-puncture-operation.pptx)–Protection with more than 160MHz PPDU and puncture operation (Liwen Chu)
  + [~~363r0~~](https://mentor.ieee.org/802.11/dcn/20/11-20-0363-00-00be-proposals-on-unused-bandwidth-utilizations.pptx)~~–Proposals on unused bandwidth utilizations (Sindhu Verma)~~
  + [384r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0384-00-00be-320-mhz-bss-configuration.pptx)–320 MHz BSS Configuration (Po-Kai Huang)
  + [398r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0398-00-00be-eht-bss-with-wider-bandwidth.pptx)–EHT BSS with wider bandwidth (Liwen Chu)
  + [399r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0399-00-00be-bw-negotiation-protection-with-more-than-160mhz-ppdu-and-puncture-operation.pptx)–BW negotiation, protection with more than 160MHz PPDU and puncture operation (Liwen Chu)
  + Agenda is slightly changed (the 1963r1 is present before 1822r4)

**Submissions**

1. [**1963r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1963-01-00be-multi-link-security-and-aggregation-operations.pptx)**–Multi-Link Security And Aggregation Operations (Huizhao Wang)**

**Summary:**

* + Establish Security Association with PMK binding at Multi-Link Device Instance level
  + Establish per Link PTKSA, GTKSA at per Link Lower-MAC level
  + Establish BA agreement at Multi-Link Device Instance level
  + Tx BA sliding window management, Rx BA reordering & scoreboard operations at the Multi-Link Device Instance level
  + Transmitter side PN assignment, and receiver side replay checking process

**Discussion:**

C:We considered that the proposal about the PTK/GTK per link. That seems to be complicated. why we have presentation proposing PTK common for all the links.

A: If you have BA agreement on MLD level you have a particular TID MPDU over different links.

C: Are you proposing we should use full state block ack?

A: I’m not proposing since the baseline already have the full stat BA For MLD spec text is how we’re gonna do full state block ack in MLD   
A: This is just another approach as option, not compete with that scheme.

C: similar to Duncun. we have already discussed in January meeting. If you started to retransmit in different links then per link PN check may have problem.

A: Same PTK cross links are fine. This is another approach.

C: we already discuss them. A little different approach.

C: Similar to duncun and po-kai. …

A: I’m not proposing reordering per link level.

C: do you still consider BA ordering per MLD level?

A: It depends on BA agreement establishment.

1. [**1822r6**](https://mentor.ieee.org/802.11/dcn/19/11-19-1822-04-00be-multi-link-security-consideration.pptx)**–Multi-link security consideration (Po-Kai Huang) [1 SP]**

* Straw Poll #2: After multi-link setup between two MLDs, do you support to use same PMK and same PTK across links with same PN space for a PTKSA and use the MLD MAC addresses to derive PMK under SAE method and PTK?

**Discussion:**

C: You wanna run this SP.

A: Based on the discussion, there are consensus on this. We can agree with it by group.

C: Can we do unanimous consent?

C: do you want to limit the PMK sharing just SAE?

A: Here, what I want to do is to use the same PMK. PMK is derived by a specific method.

C: Maybe you can have two SP here.

A: Do you want to separate them?

C: This is first straw poll.

A: I have no problem.

C: we have 10 minute per SP. Is this guideline valid for this?

C: In my opinion, if we have the different PTK on different links, we can exchange the reordering and replay detection part…. I think Huizhao presentation, different PTK in different links still works.

* **Straw Poll #2: After multi-link setup between two MLDs, do you support to use same PMK and same PTK across links with same PN space for a PTKSA?**

SP result: 35 yes/ 10 No/ 22 abstain/15 no answer

Note that this is not motion

* **Straw Poll #3: After multi-link setup between two MLDs, do you support to use the MLD MAC addresses to derive PMK under SAE method and PTK?**

**Discussion:**

C: Could you modify the SP a little bit? Like do you support to use the MLD ID (e.g., MAC address,..)...?

A: This is what we discussed in the other day.

C: MLD ID can be numerical ID.

A: It may be collision problem if we use ID. In spec we already use MAC address.

C: If we limit the MAC address, we may have issue or be wrong.

C: I supportive this SP. SAE method is done before the multi-link setup. At this time STA may not have MLD MAC address. How do we go about that?

A: We may have additional ID. This is something to use after the multi-link setup.

C: I don’t have any straw poll I would prepare for today.

A: I want to defer this.

**SP is defered.**

1. [0054r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0054-00-00be-mld-mac-address-and-wm-address.pptx)–MLD MAC address and WM address (Po-Kai Huang)

**Summary:**

If different APs of a non-AP MLD shall have different MAC address then the different non-AP STS

Propose to indicate AP MLD MAC address and non-AP MLD MAC address during the multi-link setup procedure

**Discussion:**

Yonggang :

C: I have two questions. I want to clarify MLD MAC address is the address for the multi-link logical entity?

A: MAC can identify the logical entity. We used to differentiate the different MLDs.

C: What is the difference between the MAC logical entity and MLD management entity?

A: MLD is new one we agree on that. MLD doesn’t exist in current architecture.

C: Can you go to SP 2?

A: AP MLD and non-AP MLD will use this address after the setup.

A: We already agree with MLD address that identify MLD.

....

C: Then could you clarify it in that?

A: We already discussed and Duncun provided that.

**Straw Poll 1:**

**Do you agree to revise the 11be SFD as follows:**

**A MLD has a MAC address that singly identifies the MLD management entity.**

Discussion:

SP result: 42 yes/ 3 No/ 17 abstian / 19 no answer

1. [**0063r1**](https://mentor.ieee.org/802.11/dcn/20/11-20-0063-00-00be-sta-mld-link-address.pptx)**–STA MLD link address (Liwen Chu)**

**Summary:**

It is good for unified link address selection rules for both AP MLD and STA MLD, i.e. both STA MLD and AP MLD have different link addresses for STAs affiliated with them

**Discussion:**

C:Fully support, but minor comment. You can say different STAs has different MAC address.

A: I’m fine.

C: for SA selection. Are you proposing to change the encapsulation procedure for MLD device here?

A: No I don’t change the encryption method.

C: not encryption but encapsulation process.

A: No I did not. I don’t need to figure out the MAC SAP address of STA MLD. I don’t want to change encryption or decryption.

C: SP 1, why do you want to put the restriction on the AP MLD whose affiliated AP can perform the simultaneous TX/RX?

A: I usually do not have the condition. In the last f2f the group has consensus. Many presentations disucss symmetric MAC address makes sense.

C: slide 5, you say that using the different link address is easy design for STA MLD that supports soft AP MLD ..... This is the change on the current encryption and decryption.

1. [1604r1](https://mentor.ieee.org/802.11/dcn/19/11-19-1604-01-00be-eht-direct-link-transmission.pptx)–EHT Direct Link Transmission (Dibakar Das)

**Summary:**

* + - * Benefits of Trigger based Direct Link transmission.
      * Challenges with Direct Link transmission
      * AP can share the time resource to the peer STAs\

**Discussion:**

C: P2P is neccessary of that both devices associated with the AP. We shouldn’t assume that the working assumption in secenario uplink traffic is hard for AP to know. ..... Have you thought about it? Do you have any potential solution for that?

A: Is it for the downlink or uplink?

C: for the uplink between the peer to peer of the direct link, the other STAs may not be associated with the AP. How that convince that?

A: How does the shared AP inform sharing AP about the exactly resource requirement if needed?

C: I have the question on the procedure. In your figure, slide 6, it seems that the direction transmission is jsut triggered by the AP. Then, they are ... transmission always on . Have you considered the case that the AP can trigger the uplink transmission and direct transmission together?

A: Your question is about overhear? That’s allow.

C: it seems like that the shared time is only for the peer to peer? whether the time can be used for UL MU and peer to peer at the same time in single PPDU?

C: I agree that for the d2d scenario, in some case,

**Adjourned at 22:00 EDT**

**Wednesday 18 March 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:04 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to modify their information in the webex application with name and affiliation and if cannot change them, send an e-mail to the secretary and the chairman.
4. The Chair reminds everyone to report their attendance by sending an e-mail to the Secretary and the Chairman himself. The webex app indicates about 97 people on the call.
   * Please send an e-mail only if the full information (name & affiliation) is not shown in the attendance list of webex.
   * Method to change the information at Webex: After excuting the webex application in the OS (not enter the meeting), if you push the “edit”button beside name and e-mail address information on top of the application, you can replace the name to Name & affiliation.   
       
     **Recorded attendance through the webex app and/or reported attendance through e-mail:**
   * **YELLOW names are not yet confirmed**
   * Abhishek Patil (Qualcomm)
   * Alfred Asterjadhi (Qualcomm)
   * Ali (Qualcomm)
   * Baokun Dig (??)
   * Carl Kain (??)
   * Cheng Chen (Intel)
   * Chunyu Hu (Facebook)
   * Dave Cavalcanti (Intel)
   * Dibakar Das (Intel)
   * Dmitry Akhmetov (Intel)
   * Duncan Ho (Qualcomm)
   * Edward Au (Huawei)
   * Gabor Bajko (Mediatek)
   * Gaurav Patwardhan (Hewlett Packard Enterprises)
   * Geonjung Ko (WILUS Inc)
   * George Cherian (Qualcomm)
   * Guogang Huang (Huawei)
   * Guoqing Li (Apple)
   * H (in webex)
   * Hang Su (??)
   * Hanseul Hong (Yonsei Univ.)
   * Harry Bims ???? (Bims Laboratories) – “harry” on list
   * Hirohiko INOHIZA (Canon Inc.)
   * Insun Jang (LGE)
   * James Yee (Mediatek)
   * Jarkko Knecht (Apple)
   * Jason Yuchen Guo (Huawei)
   * Jeongki Kim (LGE)
   * Jinjing Jiang (Apple)
   * John Sun (WILUS)
   * John Yi (?????) – no affiliation
   * Jonas Sedin (Ericsson)
   * Joseph Levy (InterDigital)
   * Kazuto Yano (ATR)
   * Laurent Cariou (Intel)
   * Lei Wang (Futurewei)
   * Liangxiao Xin (Sony)
   * Li-Hsiang Sun (InterDigital)
   * Lili hervieu (?? In webex)
   * Liwen Chu (NXP)
   * Liuming Lu (ZTE)
   * Manish Kumar (NXP)
   * Mark Hamiton (CommScope/Ruckus)
   * Matthew Fischer (Broadcom)
   * Ming Gan (Huawei)
   * Minyoung Park (Intel)
   * Mitsuyoshi Yukawa (Canon)
   * Mohamed Abouelseoud (Sony)
   * NaMyeong Kim (LGE)
   * Noel Stott (Keysight Technologies)
   * Osama Aboul-Magd (Huawei)
   * Patrice Nezou (Canon)
   * Paul Cheng
   * Payam Torab (Facebook)
   * Prabodh Varshney (Nokia)
   * Po-kai Huang (Intel)
   * Pooya Monajemi (Cisco)
   * Rojan Chitrakar (Panasonic)
   * Ronny Yongho Kim (KNUT)
   * Sang Kim (LGE)
   * Sharan Naribole (Samsung)
   * Shubhodeep Ahikari (Broadcom)
   * Sindhu Verma (Broadcom)
   * Srinivas Kandala (Samsung)
   * Stephane Baron (Canon)
   * Subir Das (Perspecta Labs)
   * Sungjin Park (LGE)
   * Taewon Song (LGE)
   * Tomo Adachi (Toshiba)
   * Viger Pascal (Canon)
   * Xiaofei Wang(Inter digital)
   * Xin Ge (??)
   * Yanjun Sun (Qualcomm)
   * Yifan Zhou (Huawei)
   * Yong Liu (Apple)
   * Yonggang Fang (ZTE)
   * Yongho Seok (MediaTek)
   * Yongsu Gwak (KNUT)
   * Yoshihiaa Kondo (ATR)
   * Young Hoon Kwon (NXP)
   * Yunbo Li (Huawei)
   * Yusuke Tanaka (Sony)
   * Zhiqianghan(ZTE)
   * Zhou Lan (Broadcom)

1. The Chair reminds that the agenda can be found in 11-20/425r2. Today we will go through submissions related to General MAC, ML constraints op.

* Technical Submissions:
  + [2125r0](https://mentor.ieee.org/802.11/dcn/19/11-19-2125-00-00be-eht-rts-and-cts-procedure.pptx)–EHT RTS and CTS procedure (Yongho Seok)
  + [0006r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0006-00-00be-proposed-corrections-to-channel-access-issues-in-802-11.pptx)–Proposed Corrections to Channel Access Issues in 802.11 (Shubhodeep Adhikari)
  + [0062r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0062-00-00be-protection-with-more-than-160mhz-ppdu-and-puncture-operation.pptx)–Protection with more than 160MHz PPDU and puncture operation (Liwen Chu)
  + [363r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0363-00-00be-proposals-on-unused-bandwidth-utilizations.pptx)–Proposals on unused bandwidth utilizations (Sindhu Verma)
  + [384r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0384-00-00be-320-mhz-bss-configuration.pptx)–320 MHz BSS Configuration (Po-Kai Huang)
  + [398r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0398-00-00be-eht-bss-with-wider-bandwidth.pptx)–EHT BSS with wider bandwidth (Liwen Chu)
  + [399r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0399-00-00be-bw-negotiation-protection-with-more-than-160mhz-ppdu-and-puncture-operation.pptx)–BW negotiation, protection with more than 160MHz PPDU and puncture operation (Liwen Chu)
  + [1959r0](https://mentor.ieee.org/802.11/dcn/19/11-19-1959-00-00be-constrained-multi-link-operation.pptx) Constrained Multi-Link Operation (Yongho Seok)
  + [226r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-00-00be-mlo-constraint-indication-and-operating-mode.pptx) MLO Constraint Indication and Operating Mode (Sharan Naribole)
  + [275r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0275-00-00be-need-for-sync-ppdu.pptx) Need for Sync PPDUs (Abhishek Patil)
  + Agenda was changed from original version.
    1. 106r1 should be in the list e.g., the same topic as 275r0.
       1. Send an e-mail before meeting if you want to change/suggest the agenda.
    2. the 2125r0 needs to be present after 0062r0
    3. Some part of 226r0 is related to ML management.
  + Again, send an e-mail if you want to change the agenda

**Submissions**

1. [1604r1](https://mentor.ieee.org/802.11/dcn/19/11-19-1604-01-00be-eht-direct-link-transmission.pptx)–EHT Direct Link Transmission (Dibakar Das) Continue to discuss (Q&A)

**Discussion:**

C: I think the idea has been … UL transmission is interesting idea and .…. Think about a complication …. Think more about that

A: 11ax already allows the Trigger based frame transmission …. can send to multiple STAs also.

C: At the multi-AP, we’re not also mentioning time resource sharing but also frequency resource. Why should we limit just your contribution to the time resource?

A: In this presentation we did not how the frequency sharing can happen? If you want to propose, we come up with the sequence.

C: I have presentation 95. If time before, I want to present the solution

C: when is the next mac time slot?

A: Is there any objection of adding the contribution now? Nobody spoke up

1. 0095r1 - **Triggered P2P transmissions, Stephane Baro**

* **Summary:**
  + P2P traffic is triggered by the AP for a “Single-User style” RU
  + a 242-tones RU aligned on a 20Mhz channel (possibly multiple of 20Mhz)
  + Uses its own preamble on its distinct channel :
  + Preferably the selected RU location corresponds to secondary channel(s)
* **Disucssion:**

C: Just clarification. Are you saying that you’re gonna adopting pddu that has different tone plan on legacy preamble, HE preamble? Don’t you have to guarantee the orthogonality as well? ....

A: I think you’re talking about slide 5 for MU PPDU format is TBD. The question on the first approach was because of SU PPDU. May be 20Mhz channel differency

C: the trigger frame is going to control the power of P2P transmission as well?

A: I think so.

C: This one is intended to the enabled multple P2P links to work.?

A: What is the multi-link P2P? Please clarify it.

C: Actually, multi P2P links.

A: we just address the single P2P.

C: what is the difference between green one and other one.?

A: serveral direct links are in serveral Rus.

C: Is this able to be harmonized with other?

.....

C: I will defer this SP.

**SP of 1604r1:**

SP: Do you agree to add the following to SFD?

* + 1. Do you support that 11be defines a procedure for an AP to share time resource obtained in a TXOP for peer to peer (STA-TO-STA) frame exchanges?
    2. SP results: 33 Yes/11No/18 abstain/30 no answer

1. [0006r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0006-00-00be-proposed-corrections-to-channel-access-issues-in-802-11.pptx)–Proposed Corrections to Channel Access Issues in 802.11 (Shubhodeep Adhikari)

**Summary:**

**CW for AC\_VO shall not be altered following the transmission of an 802.11 beacon**

* + The traffic multiplexing rules in 802.11be and 802.11ax shall require that for both DL and UL, for triggered as well as contention-based modes and for SU as well as MU-MIMO/MU-OFDMA transmissions, the following rule is followed:

The duration of transmission shall not be longer than the minimum required to transmit the traffic of equal or higher priority relative to the access category that was used to obtain access to the channel (i.e. the primary AC)

**Discussion:** Po-kai, Yunbo, Lei

C: Two comments. For this proposal 1, should you be going to Revmd or do you intend to fix this by EHT AP? It is only for 11be AP or Revmd?

A: the open for disucssion. at least for EHT AP.

C: Maybe you want to clarify. If you want to fix the other version, you can go to directly REVmd. In you proposal 2, if you want to fix for the 11ax you have to go to 11ax.

A: I understand If the group has a techincal question.

C: First, do you think we need to cosider the following packet transmission? ....

....

1. [0062r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0062-00-00be-protection-with-more-than-160mhz-ppdu-and-puncture-operation.pptx)–Protection with more than 160MHz PPDU and puncture operation (Liwen Chu)

**Summary:**

**Discussion:**

C: I think what you’re suggesting is MAC solution. I’m wondering whether there could be a PHY solution for it .

A: We don’t need the PHY header. This is MAC issue. Same as 11ac RTS/CTS. The legacy STAs do not understand that.

C: I have some questions on option 1. you envisioned that RTS/CTS both gonna be understood by the legacy STAs ... AP and STA have the same design?

A: No same. it may need a new control frame. we have one or two subtype of control frame. We will define new extended control frame format. .....

C: That’s right. I think generally I agree with the approach. .... the legacy STAs need a duration.

A: No, the legacy STAcannot understand the bandwidth in 11ac frame.

A: legacy STA cannot understand new information in new frame.

C: This could be sent using non-HT PPDU for Legacy STA to know duration of new frame

....

**SP1: Do you support that 11be defines a MAC mechanism to protect TXOP for PPDUs with >160MHz and/or PPDUs with preamble puncturing?**

41yes/5no/17abstain/31no answer

1. [2125r0](https://mentor.ieee.org/802.11/dcn/19/11-19-2125-00-00be-eht-rts-and-cts-procedure.pptx)–EHT RTS and CTS procedure (Yongho Seok)

**Summary:**

* 802.11be can efficiently utilize more wider 240/160+80/320/160+160 MHz bandwidth through the preamble puncture mechanism.
  + Because the chance that continuous channels of 240/320 MHz are idle is very low.
* proposes the RTS and CTS support for the preamble puncture mechanism (including a support of new bandwidth modes)

**Discussion:**

C: question about signaling put in any/MU RTS for puncturing mode. If we can how we will be that? I know this PHY design is in muti-RU. maybe, the punctured can already cover multi-RU signaling design.

A: Sure. I agree with you This is just one of example we need to consider puncturing information.

C: I’m not saying that we should not do that. Just want to see I agee with you.

A: Probably talking about not this one but another one.

C: Right.

C:Slide 9, EHT AP transmits on the busy channel

A: It’s typo. This is txop responder.

C: slide 12, ...

**SP 1: Do you support to transmit the MU-RTS/RTS and CTS frames in a non-HT duplicate PPDU on 20 MHz subchannels which are not punctured?**

35yes/2 no/18abstain/26no answer

The meeting was adjourned at 22:00

**Monday 23 March 2020, 10:00 – 13:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:03 EDT. The Chair introduces himself and the Secretary, Jeongki Kim
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 recommends to modify their information in the webex application with name and affiliation and if cannot change them, send an e-mail to the secretary and the chairman.
4. The Chair reminds everyone to report their attendance by sending an e-mail to the Secretary and the Chairman himself. The webex app indicates about 73 people on the call.  
     
   **Recorded attendance through the webex app and/or reported attendance through e-mail:**
   * **YELLOW names are not yet confirmed**
   * Abhishek Patil (Qualcomm)
   * Akira Kishida (NTT)
   * Alan Zelenznikar (??)
   * Albert Bredewoud (Broadcom)
   * Alfred Asterjadhi (Qualcomm)
   * Arik Klein (??)
   * Carl Kain (??)
   * Cheng Chen (Intel)
   * Chunyu Hu (Facebook)
   * Davide Magrin (?)
   * Dibakar Das (Intel)
   * Dmitry Akhmetov (Intel)
   * Duncan Ho (Qualcomm)
   * Edward Au (Huawei)
   * Gaurav Patwardhan (Hewlett Packard Enterprises)
   * Geonjung Ko (WILUS Inc)
   * George Cherian (Qualcomm)
   * Guogang Huang (Huawei)
   * Guoqing Li (Apple)
   * Hanseul Hong (Yonsei Univ.)
   * Harry Bims ???? (Bims Laboratories) – “harry” on list
   * Hirohiko INOHIZA (Cannon)
   * Insun Jang (LGE)
   * James Yee (Mediatek)
   * Jarkko Knecht (Apple)
   * Jason Yuchen Guo (Huawei)
   * Jeongki Kim (LGE)
   * John Son (WILUS)
   * John Yi (?????) – no affiliation
   * Jon Rosdahl (Qualcomm)
   * Jonghun Han (Samsung)
   * Joseph Levy (InterDigital)
   * Kazuto Yano (ATR)
   * Lalit
   * Lei Wang (Futurewei)
   * Li-Hsiang Sun (InterDigital)
   * Lili hervieu
   * Liwen Chu (NXP)
   * Liuming Lu (ZTE)
   * Mark Rison (Samsung)
   * Ming Gan (Huawei)
   * Mohamed Abouelseoud
   * NaMyeong Kim (LGE)
   * Osama Aboul-Magd (Huawei)
   * Patrice Nezou (Canon)
   * Po-kai Huang (Intel)
   * Pooya Monajemi (Cisco)
   * qiangguo
   * Rojan Chitrakar (Panasonic)
   * Ronny Yongho Kim (KNUT)
   * Sang Kim (LGE)
   * Sharan Naribole (Samsung)
   * Sindhu Verma (Broadcom)
   * Stephane Baron (Canon)
   * Subir Das (Perspecta Labs)
   * Sungjin Park (LGE)
   * Taewon Song (LGE)
   * Tomo Adachi (Toshiba)
   * Viger Pascal (Canon)
   * Xiaofei (Inter digital)
   * Yanjun Sun (Qualcomm)
   * Yifan Zhou (Huawei)
   * Yonggang Fang (ZTE)
   * Yongho Seok (MediaTek)
   * Yongsu Gwak (KNUT)
   * Yoshihisa Kondo (ATR)
   * Young Hoon Kwon (NXP)
   * Yunbo Li (Huawei)
   * Zhiqiang Han (ZTE)
   * Zhou Lan (Broadcom)

1. The Chair reminds that the agenda can be found in 11-20/425r9. Today we will go through submissions related to General MAC, ML contraints OP.

* Technical Submissions:
  + [384r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0384-00-00be-320-mhz-bss-configuration.pptx)–320 MHz BSS Configuration (Po-Kai Huang)
  + [398r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0398-00-00be-eht-bss-with-wider-bandwidth.pptx)–EHT BSS with wider bandwidth (Liwen Chu)
  + [~~399r0~~](https://mentor.ieee.org/802.11/dcn/20/11-20-0399-00-00be-bw-negotiation-protection-with-more-than-160mhz-ppdu-and-puncture-operation.pptx)~~–BW negotiation, protection with more than 160MHz PPDU and puncture operation (Liwen Chu)~~
  + [1993r1](https://mentor.ieee.org/802.11/dcn/19/11-19-1993-01-00be-discussion-about-single-and-multiple-primary-channels-in-synchronous-multi-link.pptx) Discussion about single and multiple primary channels in synchronous multi-link (Yunbo Li)
  + [1305r0](https://mentor.ieee.org/802.11/dcn/19/11-19-1305-00-00be-synchronous-multi-link-operation.pptx) Synchronous multi-link transmission (Yongho Seok)
  + [0026r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-00-00be-mlo-sync-ppdus.pptx) MLA Support for Constrained Devices (Duncan Ho)
  + [0081r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0081-01-00be-mlo-synch-transmission.pptx) MLO-Sync-TX (Matthew Fischer)
  + [0082r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0082-00-00be-synchronous-transmitter-medium-state-information.pptx) Synchronous-Transmitter-Medium-State-Information (Matthew Fischer)
  + [0106r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0106-01-00be-follow-up-on-performance-aspects-of-mlink-ops-with-constrains.pptx) Follow up on performance aspects of multi link operations with constrains (Dmitry Akhmetov)
  + [0134r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0134-00-00be-multilink-channel-access-considering-str-capability.pptx) Multilink channel access considering STR capability (Hanseul Hong)

**Submissions**

1. 384r1–320 MHz BSS Configuration (Po-Kai Huang)

**Summary:**

* propose to have EHT channel width field and EHT CCFS field to jointly indicate BSS operating bandwidth with indication in VHT operation element and HT operation element in 2.4/5 GHz band or HE element in 6 GHz band.

**Discussion:**

C: How are the EHT channel widths indicated ?

A: For now, at this point we have 320. What i mean the SP doen’t have the size of the field. we need the field help us to do that. I have no way to say what is the size of this.

C: you think presence of EHT CCFS would tell you?

A: 320 uses a reserved field. Basically, tell me difference.

C: Is that your question?

A: I think we just make sure that 0 would not be confused actual indication. I mean what I propose aligned with Huawei done before.

C: why we use the channel width and we use the channel centerfrequecy differentiates the contiguous and non-contiguous operation. In this case you have the channel width field.

...

A: I guess probably you talk about the puncturing. This slides doen’t cover any puncturing. .... you need to tell you we need to know what is the location

.....

**SP#1 384r0**

* **Do you support to define EHT operation element with the following fields to indicate 320/160+160 MHz BSS bandwidth?**
  + **Channel Width field**
  + **CCFS field**

26 Yes/3No/21Abstain/19no answer

1. 398r2–EHT BSS with wider bandwidth (Liwen Chu)

**Summary:**

EHT Operation element indicates > 160/80+80MHz or not, and EHT CCFS.

* + <=160MHz channelization is announced through HT/VHT/HE Operation element
  + An EHT AP/STA uses HT/VHT/EHT Operation element to announce the BW that is not more than 160/80+80MHz and doesn’t include punctured 20MHz channels

**Discussioin:**

C:Silde 2, the punctured operating channel means that BSS channel is punctured statiscally before announcement.Right?

A: Yes. This is two. One is statiscal one. Annouced by an operating element. Another is dynamical one. This is two possbile.

C: we can puncture 20MHz channel space by CCA . I’m wondering what are the use cases or advantages with a static punctured operating channel.

A: the interference with a incumbent users.

C: Due to the incumbent STAs, the inferference of a BSS.

A: Yes, the static punctured channel is mainly used for incumbent users.

C: on slide 9 unpunctured 20MHz channel is never punctured. it may this design impacts on the PHY design.

A: This STA has a single receiver. STA need to decode from 120MHz SIG or Trigger frame. ... .

C: Slide 6, if the BA problem, what do you think about RTS/CTS? Then, the CTS cannot be sent more than 160.

A: Basically, AP will not use RTS/CTS. For MU-RTS/CTS, it can do something by MU-RTS/CTS.

C: But CTS transmission only limits to 160.

...

C: Two questions. First is for the statical proposal, when the ... probably 80 or 160. How does the legacy STA know that?

A: I did not discuss dynamic one. If this dynamic punctured address legacy STA you will not use the wider bandwidth.

....

C: Two things are I want to check with you. First is about statical puncturing. It’s incumbent. Is it only for 6GHz right?

A: At least 6GHz band. But I’m not sure for 5ghz.

C: How about 11ax?

A: what do you mean 11ax AP?

C: Basically, 11ax also is in 6GHz band. There are also incumbents

A: I can’t answer.

C: just reminder me that how we will deal with this in 11ax.

1. [1993r1](https://mentor.ieee.org/802.11/dcn/19/11-19-1993-01-00be-discussion-about-single-and-multiple-primary-channels-in-synchronous-multi-link.pptx) Discussion about single and multiple primary channels in synchronous multi-link (Yunbo Li)

**Summary:** Explain the effects and issues of multiple primary link for non-STR operation. Suggesting the single primary link

**Discussioin:**

C: I have a clarification. In your presentation, you assume a single primary link you prefered. a single primary channel is used for management frame like beacon or use for the channel access?

A: only talk about the channel access. Not touch for management. Here for channel access

C: for channel access. If one link is occupied by OBSS, we allow this MLD to transmit to other link.

A: We have the prefered solution one primary link.

...

C: clarification questions. When you access the link used on primary, ... I expected other link are you planing to ... from other link or what you have in mind?

A: It’s for simplexity It’s just PIFS sensing. ... So, My preference uses PIFS check on the secondary link.

C: Have you thought PIFS access is allowed from regulatory point.

A: Is this different from 80+80? What is difference from two scenarios?

C:Regulatory I think it may not be like policy. We cannot use PIFS. Because, PIFS is .11 terminology.

....

Chair: Please go to offine discussion. It’s not easy one.

C: Second question. You’re considering R1 or R2?

A: I agree that from the priority level, that maybe should go STR one. not thinking it’s better to complete leave to R2. .... we parallel discussion on STR and non-STR. Make it more easy.

C: non-STR should in R2, R1 preclude it.

A: At least we shouldn’t exclude it.

1. 1305r1 Synchronous multi-link transmission (Yongho Seok)

**Summary:**

To avoid that a STA transmit and receive frames on multi-link simultaneously, it may synchronize the starting times and ending times of the PPDU transmissions on multi-link.

discusses a synchronization requirement of the PPDU transmissions

**Discussioin:**

C: This PPDU alignment and ending are you motivating the constraints AP MLD or AP is non-contraints and non-AP is constraints?

A: Contraints is generalized. in the SP, AP MLD is not required. This is non-STR MLD. But Usually AP MLD regards it. ...

C: AP is STR, non-STR devices. In this case, you want to alignment the ending?

A: Yes

C: I think ending time alignment is very important for the case that ...? I don’t think we agree with fixing this requirement. ... Maybe we should run the SPs to mandate ending time alignment on AP side?

A: we can do. Basically, this is not that the AP that is aligned.

C: I’m not against this proposal. This proposal is good. Firstly make mandating the requirement on AP side. Ending time alignment is needed?

A: Do you suggest the SP?

C: In your presentation, you mention 10% of SIFS. I don’t see in other texts you . In your straw poll, that is TBD. You have other factor? What do you think?

A: Still receiving the offline comments. They want the feedback from PHY. I want to give more time for detailed value.

C: second Zhou’s comment. Probably, this SP is static is fine. We will probably need to first agree that the PPDU alignment ....

C: maybe you need to work with zhou. Mandatory requirement.

A: another separate topic..

C: I will allocate the 10 min for Q&A

**The meeting was adjourned at 13:00**

**Thursday 26 March 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:00 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 and Jon (Qualcomm) recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The webex app indicates about 94 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Abdelaal, Rana | Broadcom Corporation |
| Abouelseoud, Mohamed | Sony Corporation |
| Aboulmagd, Osama | Huawei Technologies Co.,  Ltd |
| Adachi, Tomoko | TOSHIBA Corporation |
| Agarwal, Peyush | Broadcom Corporation |
| Akhmetov, Dmitry | Intel Corporation |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Au, Kwok Shum | Huawei Technologies Co., Ltd |
| baron, stephane | Canon Research Centre France |
| Bredewoud, Albert | Broadcom Corporation |
| Carney, William | Sony Corporation |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Das, Dibakar | Intel Corporation |
| Derham, Thomas | Broadcom Corporation |
| de Vegt, Rolf | Qualcomm Incorporated |
| Fang, Yonggang | ZTE TX Inc |
| Fischer, Matthew | Broadcom Corporation |
| Gan, Ming | Huawei Technologies Co., Ltd |
| Garg, Lalit | Broadcom Corporation |
| Ghosh, Chittabrata | Intel Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Hamilton, Mark | Ruckus/CommScope |
| Hedayat, Ahmadreza | Charter Communications |
| Hervieu, Lili | Cable Television Laboratories Inc. (CableLabs) |
| Hirata, Ryuichi | Sony Corporation |
| Ho, Duncan | Qualcomm Incorporated |
| Hong, Hanseul | Yonsei University |
| Hu, Chunyu | Facebook |
| Huang, Po-Kai | Intel Corporation |
| Jang, Insun | LG ELECTRONICS |
| Jiang, Jinjing | Apple, Inc. |
| Kandala, Srinivas | SAMSUNG |
| Kim, Jeongki | LG ELECTRONICS |
| kim, namyeong | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Yongho | Korea National University of Transportation |
| Kneckt, Jarkko | Apple, Inc. |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Levy, Joseph | InterDigital, Inc. |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Liu, Yong | Apple, Inc. |
| Lv, kaiying | MediaTek Inc. |
| Liuming Lu | ZTE |
| Lv, Lily | Huawei Technologies Co. Ltd |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Naribole, Sharan | SAMSUNG |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Raissinia, Alireza | Qualcomm Incorporated |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Sedin, Jonas | Ericsson AB |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wang, Xiaofei | InterDigital, Inc. |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| Zeleznikar, Alan | CommScope |
| Zhou, Yifan | Huawei Technologies Co., Ltd |

1. The Chair reminds that the agenda can be found in 11-20/425r12. Today we will go through submissions related to ML-Constrained Ops.

* Technical Submissions:
  + [~~0026r0~~](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-00-00be-mlo-sync-ppdus.pptx) ~~MLA Support for Constrained Devices (Duncan Ho)~~
  + [0026r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-01-00be-mlo-sync-ppdus.pptx) MLO: Sync PPDUs (Duncan Ho)
  + [0081r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0081-01-00be-mlo-synch-transmission.pptx) MLO-Sync-TX (Matthew Fischer)
  + [0082r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0082-00-00be-synchronous-transmitter-medium-state-information.pptx) Synchronous-Transmitter-Medium-State-Information (Matthew Fischer)
  + [0106r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0106-03-00be-follow-up-on-performance-aspects-of-mlink-ops-with-constrains.pptx) Follow up on performance aspects of multi link operations with constrains (Dmitry Akhmetov)
  + [0134r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0134-00-00be-multilink-channel-access-considering-str-capability.pptx) Multilink channel access considering STR capability (Hanseul Hong)
  + [1959r0](https://mentor.ieee.org/802.11/dcn/19/11-19-1959-00-00be-constrained-multi-link-operation.pptx) Constrained Multi-Link Operation (Yongho Seok)
  + [~~0026r1~~](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-01-00be-mlo-sync-ppdus.pptx) ~~MLO: Sync PPDUs (Duncan Ho)~~
  + [188r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0188-00-00be-multi-link-triggered-uplink-access.pptx) Multi-link Triggered Uplink Access (Yongho Seok)
  + [226r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-00-00be-mlo-constraint-indication-and-operating-mode.pptx) MLO Constraint Indication and Operating Mode (Sharan Naribole)
  + [275r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0275-00-00be-need-for-sync-ppdu.pptx) Need for Sync PPDUs (Abhishek Patil)
  + [291r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0291-00-00be-mlo-async-and-sync-operation-discussion.pptx) MLO Async. and Sync. Operation Discussion (Zhou Lan)
  + [329r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-00-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx) Group addressed frame transmission in constrained multi-link operation (Yongho Seok)
  + [414r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0414-00-00be-method-for-handling-constrained-mld.pptx) Method for Handling Constrained MLD (Insun Jang)
  + [415r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-00-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx) Multi-link Aggregation: Synchronized PPDUs on Multiple Links (Insun Jang)
  + [433r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-00-00be-ppdu-alignment-in-str-constrained-multi-link.pptx) PPDU alignment in STR constrained multi-link (Yunbo Li)
  + [444r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0444-00-00be-mla-non-str-sta-edca-rules-after-self-interference.pptx) MLA: Non-STR STA EDCA rules after self-interference (Duncan Ho)
  + [455r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-00-00be-async-mlo-with-non-str-sta.pptx) Async multi-link operation for non-STR STA (Dmitry Akhmetov)
  + [487r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-00-00be-multiple-link-operation-follow-up.pptx) Multiple link operation follow up (Liwen Chu)
  + [490r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0490-00-00be-multi-link-hidden-terminal.pptx) Impact\_of\_channel\_blindness\_ML\_txrx (Dibakar Das)
  + Firstly 1305r1 was present only for SP

**Submissions**

1. 1305r1 Synchronous multi-link transmission (Yongho Seok) (SP only)

* **SP1: Do you support the following PPDU transmission restriction for the constrained multi-link operation?** 
  + **If an AP MLD intends to align the ending time of the DL PPDUs simultaneously sent on the multiple links, the AP MLD shall ensure that the difference between the ending times of transmitting PPDUs is less than SIFS – margin time.**
    - **Where the reference of the ending time of the PPDU is TBD and the margin time (< SIFS) is TBD.**

**Discussion:**

C: I noticed you have the following slides talking about TB PPDU. For TB PPDU, I also submitted the related contribution. It may be different from this.

A: what is your suggestion?

C: Adding ” without carrying Trigger frame (having CS Required field set to1)”

SP text is changed with new text

C: What is the difference between this one and previouse one?

A: Yunbo just want to discuss this case. He has the related contribution

C: how is the rule changed for the Trigger frame? Is it different margin time? You can just add the N value? I think it covers all.

A: No, the equation can be changed from this one based on the discussion. If we include that in this case, ....

Chair: there is two different views. Yongho, do you want to run SP?

C: I will check the yunbo slides.

C: without carrying ...?

A: This is not the spec text. In the spec text we can consider your suggestion.

C: Is there any other exception except for Trigger frame?

C: I don’t think so. Need the different requirement for different scenario

A: Pooya, want to make it general. This is too specific. I think this is the high level concept. I want to delete this . I believe this does not exclude your suggestion.

C: I think this have different meaning. If you delete it, I will vote no.

A: OK

SP text is changed to original version.

SP: 29 yes/10 no/27abstain/20no answer

If someone missed his voting in the poll system, he sent his voting (no answer -> No) to the chair through e-mail. The result was changed from 9 No (shown in poll system) to 10 No.

During the call, there was a problem on his polling system and he asked the chair. The chair requested to send the chair his vote through e-mail. The chair mentioned that the voting result can be changed.

1. 0026r2 MLO: Sync PPDUs (Duncan Ho)

**Summary:**

Proposing the methods of Sync PPDU TX either with SMEA or without SMEA

**Discussion:**

C: slide 5, left side figure SMEA case, you said if the other link get access, you reset the backoff count to zero? That means sfter PPDU transmission, the backoff is reset? Remain 4 or zero

A: Yes. This will be zero then we can transmit PPDU2

C: what if the back off count become zero on link 1, at that time what if link 2 still DIFS?

A: In that case, we has to wait for DIFS.

C: In SP 2, AP indicates if it’s capable of.... then what’s gonna be the AP behavior after AP said ....

A: AP will ”shall” try to align the end time of PPDU as much as possible.

C: it’s kind of shall

C: STA already receives frame on link 1, why does the PPDU is lost? STA can send the RTS on link2 ...

A: That’s optional. There is option 2. If the STA is intelligent, the link 2 can hold off ...

C: In option 2, in case of OBSS transmission, by PHY header, STA can know, and the STA can resume the count down on link 2. why even OBSS case holding off counting down.

A: I see. I focus on the down link. Forget the OBSS.

C: slide 6, you mentioned PD or NAV check. EU regulation PIFS check is up to 160 right? This is defined in 5GHz, 6GHz rule still under development. We can apply this rule on the cross links case.

A: For the regulatory, I don’t believe this is an issue.

C: why do you think of it?

A: FCC doesn’t have such restriction.

C: EU has that’s regulation

A: we can discuss offline.

C: SP2, Do you mean that AP indicates the capability of aligning for STR capable?

A: No, whole thing is about non-STR case.

C: you comined two SP

C: if you have AP is STR and STA is non-STR. In that case also this rule could be used, you mention

C: Intel has also some contribution related to this. 107, 455,

A: Is it uplink?

C: I still have couple fairness with this one, slide 6 on link 2. Actually, STR can back off count.

C: slide 6, on 2nd link, regulation issue may bring up. You can look at EC EN 301 803 for adopt the channel access. Please look at it. If we have concen....

C: slide 6, if you take this maximum count down, ... link 1

A: link 1 is 7 link 2 is 5.

C: slide 8, that example, it’s different from STA side. .. In option 2, STA is not integration..

A: In option 1, 2 we don’t touch STA.

C: SP2, ... signaling, it’s not shall requirement. There is three cases. ...

C: In SP2, please delete the note.

Chair: No repeat the question.

C: if link1 has long transmission, then you have to do padding to align the ending time. Do you want to align always?

C: slide 8, AP does not know STA has uplink traffic.

C: SP2: mandatory is align. If AP1 has long packet, AP2 gets the channel.

C: slide 8 to avoid these issues, a single primary channel is usefull.

C: SP2, I want to add the note. It can be shall or may.

C: SP 1, what does it mean? You don’t consider non-STR AP?

A: for timeline, I only mentioned STR AP.

C: we can add if the AP can non-STR AP in R1

C: slide 6, NAV issue & fairness issue.

C: SP 2, trigger can be good solution for solving this.

A: NAV situation, we already address it. We have second contribution which include it.

A: we are not precluding other options. This is simplication.

Chair: Duncun do you run the SP?

**SP is deferred**

1. [0081r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0081-01-00be-mlo-synch-transmission.pptx) MLO-Sync-TX (Matthew Fischer)

**Summary:**

Proposing several mechanisms for synchronous transmission of non-STR STA

**Discussion:**

C: Are you suggesting that the non-STR MLD also try to synchronized transmission like multiple links?

A: Yes. I’m suggesting that.

C: Have you considering this synchornizing transmission on multiple links? .... I’m wondering that conditions we will current the network to favorite such protocol.

A: The issue separate from previous presentation, are loosing my ability. EDCA medium state on the other link that I’m transmitting. Some other transmitters ... I get lost, then my EDCA goes to hell.

C: I see. I have presented the doc number 11-19/1405 we also look that for non-STR MLD. it’s NAV status, it’s not synchronized any more. We’re solution that the considering of access point feedback it can NAV status or busy status on the other links.

...

A: I don’t know about padding ..., my next item on the agenda is my document 82 which is similar to what you’re talking about in 1405. ... Yes, another solution is ... better.

C: Are you trying to run SP?

A: No, I don’t think.

C: slide 2, Can I call the blindess problem? If you’re saying that non-STR AP STA transmits on one then I loose my CCA on another one. You try to study the single NAV to reserve instead of mechanism. I summarize right?

A: That’s the basic.

C: From our side, Dibakar has slides on blindess problem. ... I understand why you try to study.

C: ... Basically one of the ways to solve PPDU aligning end of the PPDU, you’re bring it in uplink side. .... I think probably the solution is like very complex having STA send the Trigger frame.

A: I don’t think that’s complex. It’s pretty very simple decision.

C: May we can offline. Too much time.

1. [0082r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0082-00-00be-synchronous-transmitter-medium-state-information.pptx) Synchronous-Transmitter-Medium-State-Information (Matthew Fischer)

**Summary:**

Proposing the methods to send the medium state information of synchronous STA (especially, for other link(s))

**Discussion:**

C: AP MLD and non-AP MLD are able to exchange the information within each other. the efficiency. .... If this one doesn’t have capability, it would not be working. Am I understanding correctly?

A: Sorry. noise.

C: Here in the slide 3, both AP side and STA side

C: Why not to like example at least establishment timer ...that You may how someone else starts transmission you think that will basically results your that not the problem. ... Something maybe help you to catch up on someone transmission particularly.

A: No. This is precluding that. This is the particular example showing that all you’re gonna see nothing because ....

C: the medium state of AP location, none of the .. without assuming the client to another.

A: There is no way to get the exact ... client let’s say impact ..

C: Yeah, my other question is is there alternative entire alignment ..

A: I think 81 is some stuff choose maybe the simpler adjustment to some closure . you can use the other situation. ... I don’t think it’s a lot of ... That’s pretty simple.

C: What I understood 81 is anyone anywhere is non-STR, everyone everywhere is align with it.

C: Similar to the previous. You address the issue within the BSS, in your analysis,

A: No, that’s the primary thing. If you can deal with that, You gotten.. part of the problems. You can do more ...

C: Are you expecting the NAV could be NAV of OBSS also?

A: if we have two NAVs, two NAVs are delivered. Both them.

C: OK. Thank you.

C: This medium state is for AP side?

A: Correct.

C: The condition of STA side may not be the same as AP

A: That’s correct. If i get information locally for receive that the best I can do.

C: This is only partial information? Right?

C: I don’t think this addition can actual set this NAV based on this information.

A: I’m proposing that would

**The meeting was adjourned at 22:00**

**Monday 30 March 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:00 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The webex app indicates about 94 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Name | Affiliation |
| Abouelseoud, Mohamed | Sony Corporation |
| Aboulmagd, Osama | Huawei Technologies Co.,  Ltd |
| Adachi, Tomoko | TOSHIBA Corporation |
| Akhmetov, Dmitry | Intel Corporation |
| Au, Kwok Shum | Huawei Technologies Co., Ltd |
| Carney, William | Sony Corporation |
| Cheng, Paul | MediaTek Inc. |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Chu, Liwen | NXP Semiconductors |
| Das, Dibakar | Intel Corporation |
| Dong, Xiandong | Xiaomi Inc. |
| Fang, Yonggang | ZTE TX Inc |
| Fischer, Matthew | Broadcom Corporation |
| Gan, Ming | Huawei Technologies Co., Ltd |
| Garg, Lalit | Broadcom Corporation |
| Ghosh, Chittabrata | Intel Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Hamilton, Mark | Ruckus/CommScope |
| Hsu, Chien-Fang | MediaTek Inc. |
| Hu, Chunyu | Facebook |
| Huang, Guogang | Huawei |
| Inohiza, Hirohiko | Canon Inc. |
| Jang, Insun | LG ELECTRONICS |
| Jiang, Jinjing | Apple, Inc. |
| Kim, Jeongki | LG ELECTRONICS |
| Kim, NaMyeong | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Yongho | Korea National University of Transportation |
| Kneckt, Jarkko | Apple, Inc. |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Levy, Joseph | InterDigital, Inc. |
| Li, Guoqing | Apple, Inc. |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Liu, Yong | Apple, Inc. |
| Liuming Lu | ZTE |
| Lv, kaiying | MediaTek Inc. |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Naribole, Sharan | SAMSUNG |
| Nezou, Patrice | Canon Research Centre France |
| Park, Minyoung | Intel Corporation |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Tanaka, Yusuke | Sony Corporation |
| Torab Jahromi, Payam | Facebook |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wang, Xiaofei | InterDigital, Inc. |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| Zeleznikar, Alan | CommScope |
| Zhou, Yifan | Huawei Technologies Co., Ltd |

1. The Chair reminds that the agenda can be found in 11-20/425r13. Today we will go through submissions related to ML-Constrained Ops.

* Technical Submissions:
  + [0106r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0106-03-00be-follow-up-on-performance-aspects-of-mlink-ops-with-constrains.pptx) Follow up on performance aspects of multi link operations with constrains (Dmitry Akhmetov)
  + [0134r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0134-00-00be-multilink-channel-access-considering-str-capability.pptx) Multilink channel access considering STR capability (Hanseul Hong)
  + [1959r0](https://mentor.ieee.org/802.11/dcn/19/11-19-1959-00-00be-constrained-multi-link-operation.pptx) Constrained Multi-Link Operation (Yongho Seok)
  + [188r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0188-00-00be-multi-link-triggered-uplink-access.pptx) Multi-link Triggered Uplink Access (Yongho Seok)
  + [226r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-00-00be-mlo-constraint-indication-and-operating-mode.pptx) MLO Constraint Indication and Operating Mode (Sharan Naribole)
  + [275r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0275-00-00be-need-for-sync-ppdu.pptx) Need for Sync PPDUs (Abhishek Patil)
  + [291r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0291-00-00be-mlo-async-and-sync-operation-discussion.pptx) MLO Async. and Sync. Operation Discussion (Zhou Lan)
  + [329r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-00-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx) Group addressed frame transmission in constrained multi-link operation (Yongho Seok)
  + [414r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0414-00-00be-method-for-handling-constrained-mld.pptx) Method for Handling Constrained MLD (Insun Jang)
  + [415r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-00-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx) Multi-link Aggregation: Synchronized PPDUs on Multiple Links (Insun Jang)
  + [433r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-00-00be-ppdu-alignment-in-str-constrained-multi-link.pptx) PPDU alignment in STR constrained multi-link (Yunbo Li)
  + [444r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0444-00-00be-mla-non-str-sta-edca-rules-after-self-interference.pptx) MLA: Non-STR STA EDCA rules after self-interference (Duncan Ho)
  + [455r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-00-00be-async-mlo-with-non-str-sta.pptx) Async multi-link operation for non-STR STA (Dmitry Akhmetov)
  + [487r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-00-00be-multiple-link-operation-follow-up.pptx) Multiple link operation follow up (Liwen Chu)
  + [490r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0490-00-00be-multi-link-hidden-terminal.pptx) Impact\_of\_channel\_blindness\_ML\_txrx (Dibakar Das)

**Submissions**

1. 0106r4 Follow up on performance aspects of multi link operations with constrains (Dmitry Akhmetov)

**Summary:**

Signaling “ end of PPDU time”

DL-Rx unavailable state indication by non-AP

**Discussion:**

C: Slide 9, here, the simulating is DL only traffic, right?

A: right.

C: I also hear same conclusion on slide 10, need to be done. I like option 1. I had a contribution last call.

C: slide 16, you mentioned TWT….

A: Here I just want to say about a separation of DL an UL traffic.

C: SP 2, we have very similar SP.

A: OK

C: how did you model it packet loss in your simulation?

C: slide 10, option 1 and 2, AP MLD PPDU ending alignment, are your option 2 …

1. [0134r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0134-00-00be-multilink-channel-access-considering-str-capability.pptx) Multilink channel access considering STR capability (Hanseul Hong)

**Summary:**

* + If semi-synchronous operation is allowed, the sensing level considering high IDC interference level and sensing period of the other links should be defined
  + For synchronous operation, the sensing period caused by the unavailability of PD and NAV setting during the transmission in other link(s) should be determined

**Discussion**: None

1. [1959r0](https://mentor.ieee.org/802.11/dcn/19/11-19-1959-00-00be-constrained-multi-link-operation.pptx) Constrained Multi-Link Operation (Yongho Seok)

**Summary:** proposes that a STA in a constrained MLD should exchange RTS/MU-RTS and CTS frames to protect frame exchange of other STAs in the MLD

**Discussion:**

C: On slide 9, it has non-STR MLD has a RTS/CTS exchange on link 1. It is transmitting A-MPDUs.

C:on the link 2 is it able to do backoff to transmit RTS. I’m confusing.

A: depending on the channel access rule non-STR device, here if this channel is busy I don’t care such about device ... we don’t define the specific rule from uplink transmission.... That can be a different issues

C: slide 7, the peer STA may not respond CTS

* **SP:** **Do you support the following constrained multi-link operation?**
  + When a STA in a non-STR MLD receives an RTS addressed to itself, if the NAV of the STA indicates idle but another STA in the same MLD is either a TXOP holder or a TXOP responder, the STA may not respond with a CTS frame.

26yes/6no/35abstain/19no answer

1. 188r1 Multi-link Triggered Uplink Access (Yongho Seok)

Summary:

Discussion:

C: slide 7, on the second link the assumption here that STA will performs CCA right after DL PPDU right? In 11ax no such requirement. It can be within the SIFS time. You’re assuming it should start right after the end of the PPDU. I think this is different from 11ax.

A: No, here may be it can be a STA depends on value. STA can perform the CCA during SIFS time but what I’m thinking is this time is margin value/margin time.

C: understand. On the figure in slide 7,even the second starts later , Trigger on other link tirggers CCA right?

A: Initially when I draw this figure , I assume that CCA is just started at the end of the PE.

C: OK

C: both link set the CS required to 1. Then other case is there is one common link CS required to 0 We also need to consider this case based on ED based.

A: We can make one general rule for both cases.

C: We can present one of my slides . the requirement is different. We need to cover this case.

C: Another is the time difference between the last DL PPDU and the first TB PPDU is ... Here is not accurate. The end of the DL PPDU should be earlier.

A: Yes.

C:What can AP control the ending time .... It may align with the SP of your another presentation.

1. [226r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-00-00be-mlo-constraint-indication-and-operating-mode.pptx) MLO Constraint Indication and Operating Mode (Sharan Naribole)

Summary:

Discussion:

**No disucssion due to no time. Will allocate some time for Q&A at next CC.**

**The meeting was adjourned at 22:00 ET**

**Monday 6 April 2020, 10:00 – 13:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The Zoom app indicates about 90 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

Aboulmagd, Osama Huawei Technologies Co.,  Ltd  
Adhikari, Shubhodeep Broadcom Corporation  
Akhmetov, Dmitry Intel Corporation  
An, Song-Haur INDEPENDENT  
Andersdotter, Amelia Article 19  
Asterjadhi, Alfred Qualcomm Incorporated  
Au, Kwok Shum Huawei Technologies Co., Ltd  
baron, stephane Canon Research Centre France  
Bei, Jianwei NXP Semiconductors  
Bredewoud, Albert Broadcom Corporation  
Carney, William Sony Corporation  
CHAN, YEE Facebook  
Cheng, Paul MediaTek Inc.  
CHERIAN, GEORGE Qualcomm Incorporated  
Chitrakar, Rojan Panasonic Asia Pacific Pte Ltd.  
Das, Dibakar Intel Corporation  
Das, Subir Perspecta Labs Inc.  
Derham, Thomas Broadcom Corporation  
Fang, Yonggang ZTE TX Inc  
Fischer, Matthew Broadcom Corporation  
Gan, Ming Huawei Technologies Co., Ltd  
Garg, Lalit Broadcom Corporation  
Ghosh, Chittabrata Intel Corporation  
Guo, Yuchen Huawei Technologies Co., Ltd  
Gwak, Yongsu Korea National University of Transportation  
Han, Jonghun SAMSUNG  
Hervieu, Lili Cable Television Laboratories Inc. (CableLabs)  
Ho, Duncan Qualcomm Incorporated  
Hong, Hanseul Yonsei University  
Hu, Chunyu Facebook  
Huang, Guogang Huawei  
Huang, Po-Kai Intel Corporation  
Jang, Insun LG ELECTRONICS  
Kandala, Srinivas SAMSUNG  
Kim, Jeongki LG ELECTRONICS  
kim, namyeong LG ELECTRONICS  
Kim, Sang Gook LG ELECTRONICS  
Kim, Yongho Korea National University of Transportation  
Kneckt, Jarkko Apple, Inc.  
Ko, Geonjung WILUS Inc.  
Kondo, Yoshihisa Advanced Telecommunications Research Institute International (ATR)  
Kwon, Young Hoon NXP Semiconductors  
Levy, Joseph InterDigital, Inc.  
Li, Yiqing Huawei Technologies Co. Ltd  
Li, Yunbo Huawei Technologies Co., Ltd  
Lv, kaiying MediaTek Inc.  
Max, Sebastian Ericsson AB  
Monajemi, Pooya Cisco Systems, Inc.  
NANDAGOPALAN, SAI SHANKAR Cypress Semiconductor Corporation  
Naribole, Sharan SAMSUNG  
Nezou, Patrice Canon Research Centre France  
Omar, Hassan Huawei Technologies Co.,  Ltd  
Park, Sung-jin LG ELECTRONICS  
Patil, Abhishek Qualcomm Incorporated  
Patwardhan, Gaurav Hewlett Packard Enterprise  
RISON, Mark Samsung Cambridge Solution Centre  
Rosdahl, Jon Qualcomm Technologies, Inc.  
Sedin, Jonas Ericsson AB  
Seok, Yongho MediaTek Inc.  
Song, Taewon LG ELECTRONICS  
Sun, Li-Hsiang InterDigital, Inc.  
Sun, Yanjun Qualcomm Incorporated  
Verma, Sindhu Broadcom Corporation  
VIGER, Pascal Canon Research Centre France  
Wang, Huizhao Quantenna Communications, Inc.  
Wang, Lei Huawei R&D USA  
Wang, Xiaofei InterDigital, Inc.  
Wentink, Menzo Qualcomm  
Yano, Kazuto Advanced Telecommunications Research Institute International (ATR)  
Yee, James MediaTek Inc.  
yi, yongjiang Futurewei Technologies  
Zeleznikar, Alan CommScope

1. The Chair reminds that the agenda can be found in 11-20/425r16. Today we will go through submissions related to ML-Constrained Ops.

* Technical Submissions:
  + [226r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-00-00be-mlo-constraint-indication-and-operating-mode.pptx) MLO Constraint Indication and Operating Mode (Sharan Naribole) [Q&A]
  + [275r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0275-00-00be-need-for-sync-ppdu.pptx) Need for Sync PPDUs (Abhishek Patil)
  + [291r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0291-00-00be-mlo-async-and-sync-operation-discussion.pptx) MLO Async. and Sync. Operation Discussion (Zhou Lan)
  + [329r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-00-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx) Group addressed frame transmission in constrained multi-link operation (Yongho Seok)
  + [414r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0414-00-00be-method-for-handling-constrained-mld.pptx) Method for Handling Constrained MLD (Insun Jang)
  + [415r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-00-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx) Multi-link Aggregation: Synchronized PPDUs on Multiple Links (Insun Jang)
  + [433r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-00-00be-ppdu-alignment-in-str-constrained-multi-link.pptx) PPDU alignment in STR constrained multi-link (Yunbo Li)
  + [444r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0444-00-00be-mla-non-str-sta-edca-rules-after-self-interference.pptx) MLA: Non-STR STA EDCA rules after self-interference (Duncan Ho)
  + [455r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-00-00be-async-mlo-with-non-str-sta.pptx) Async multi-link operation for non-STR STA (Dmitry Akhmetov)
  + [487r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-00-00be-multiple-link-operation-follow-up.pptx) Multiple link operation follow up (Liwen Chu)
  + [490r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0490-00-00be-multi-link-hidden-terminal.pptx) Impact\_of\_channel\_blindness\_ML\_txrx (Dibakar Das)

**Submissions**

1. 226r2 MLO Constraint Indication and Operating Mode (Sharan Naribole) [Q&A]

Discussion: No discussion for Q&A.

I have SPs.

**SP 1:** **Do you support the addition of following text to the TGbe SFD?**

* **STR mode**, in reference to a pair of links, is defined as the operating mode in which an MLD indicates the ability to support reception on one link while simultaneously transmitting on the other link.
  + NOTE - Specific requirements is TBD
* **Non-STR mode**, in reference to a pair of links, is defined as the operating mode in which an MLD indicates constraints to support reception on one link while simultaneously transmitting on the other link.
  + NOTE - Specific constraints indicated is TBD

Defer to SP1.

Main comments recommend to indicate the capability of STR/non-STR instead of the mode definition.

Chair recommends to take offline discussion with people and improve the SP text.

Sharan did not run SPs

1. 275r2 Need for Sync PPDUs (Abhishek Patil)

**Summary:**

Need of Sync PPDUs

Explains pitfalls of non sync PPDUs (e.g., if preamble is lost, whole ppdu is gone.)

Performace analysis between sync PPDU and non sync PPDU

**Discussion:**

C: Non-sync mode you consider in your contribution, non-AP MLD, why 0(starvation of UL)?

A: slide 8 explain the example. .. So, result shows the value 0

C: did you consider RTS/CTS in your simulation?

A: No

A: JMPC is start and end are synchronized.

C: For JMPC, is used for both AP and non-AP? Or just one?

A: Both sides.

C: AP may use different medium access mechanism…

C: slide 12, JMPC, do you consider if one link is idle and other link is busy? In that case, the TX is pending,

A: Another link has a chance then other link ....

C: slide 4, if PPDU1 and PPDU2 are in different MLD, two PPDUs should be aligned?

A: No. Here assuming the same MLD.

C: slide 8, I have same question on same scenarios.

A: No, in this case I assume that the same MLD, … do you mean that link 1 is DL of a AP MLD and link 2 is UL of other non-AP MLD?

C: Yes,

A: I think in that case there is same situation (starvation of UL)… explaining…

C: slide 8, why here does the STA hold off counting down? I think if the STA can check the CCA and the channel is idle then the STA can transmit UL. I don’t think it’s reasonable.

A: ….

A: I assume that AP has full buffer.

…

C: slide 11, JMPC, I think JMPC has the gain more than double rather than single link. Why just double?

Chair recommends Regarding the simulation, go to offline discussion.

C: For JMPC, the alignment is only for ending time or both start and ending?

A: JMPC has the alignment of both sides.

C: I wanna show the simulation result for more STAs.

C: Are you running full bffer,?

A: for DL full buffer, …

1. 20/291r1 MLO Async. and Sync. Operation Discussion (Zhou Lan)

**Summary:**

* + - **Async. TX, Async RX scenario**: A ~~STA/~~AP MLD under **Non-Constrained** mode transmits data and solicits response from a STA~~/AP~~ MLD under **Non-Constrained** mode
    - **Async. TX, Sync RX scenario**: A ~~STA/~~AP MLD under **Non-Constrained** mode transmits data and solicits response from a STA~~/AP~~ MLD under **Constrained** mode
    - **Sync. TX, Async RX scenario**: A STA~~/AP~~ MLD under **Constrained** mode transmits data and solicits response from a ~~STA/~~AP MLD under **Non-Constrained** mode
    - **Sync. TX, Sync RX scenario**: A STA/~~AP~~ MLD under **Constrained** mode transmits data and solicits response from a ~~STA~~/AP MLD under **Constrained** mode

Proposing several operations for each scenarios.

**Discussion:**

C: slide 9, the gap between Ack and Trigger, some STA can tranmit the frame during gap.

A: Here we use NAV protectin of RTT (and Ack frames). I agree with you. It may be possible. I think it’s endurable.

C: slide 11, CTS to self is used to align the ending time of link 1 and link2. How does the AP know the ending time of link?

A: Trigger on link 1 indicates the ending time of PPDU on link1 and AP1 and AP2 can exchange the information on ...

C: slide 9 I have the same concern with Yongsu.

C: slide 7, what is the CTS-A? Is it new?

A: no it’s just cts to self.

C: slide 11, cts to self frame can be interfered by A-MPDU of link2.

A: .... I don’t have better solution.

C: I’ll think about more

C: slide 9, what is the sync. Tx and async rx?

A: AP is STR, STA is non-STR. This is basic assumption. In this case, STA transmits the uplink frame, ....

C: My question is what async RX means?

.....

A: slide 6, CTS can be overlapped with partial part of DL frame. RTS/CTS on link 2 can be ....

C: STR and non-STR, which cases do you consider to be in R2?

A: last thing should be in R2.

C: You don’t consider non-STR AP?

A: Yes.

C: don’t you consider PIFS rule for transmitting sync PPDU?

A: we need to consider regulatory and need to study the unfairness issue chunyu mentioned?

C: how much topic should be in spec or in implementation in your contribution?

A: I slightly prefer the slide 7.

C: I think the operation is already allowed in the spec.

C: we need to narrow down which should be in R1

C: RTS/CTS case problem.

A: I prefer case 1 rather than case 2.

C; (slide 9) on link 1 TXOP owner is STA1, but on link 2 2 TXOP owner is AP2

C: R1/R2 is impartant topic. Need to be discussed

Chairman: if it’s important, please submit the related contribution

C: there are some contribution related to R2/R1. I request to present the r1/r2 contributions in this week calls.

C: It might block other presentation. Please discuss it during the call.

1. [329r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-00-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx) Group addressed frame transmission in constrained multi-link operation (Yongho Seok)

Summary:

**In order to reliably deliver a group addressed frame to a constrained non-AP MLD, an AP MLD should not schedule to the non-AP MLD a frame exchange sequence which overlaps with the group addressed frame of other link(s).**

Discussion: No discussion due to out of time

Will allocate the time for Q&A at next call

**The meeting was adjourned at 12:55**

**Thursday 9 April 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The Zoom app indicates about 90 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

Abouelseoud, Mohamed Sony Corporation  
Aboulmagd, Osama Huawei Technologies Co.,  Ltd  
Adachi, Tomoko TOSHIBA Corporation  
Andersdotter, Amelia None - Self-funded  
Asterjadhi, Alfred Qualcomm Incorporated  
Au, Kwok Shum Huawei Technologies Co., Ltd  
baron, stephane Canon Research Centre France  
Bredewoud, Albert Broadcom Corporation  
Carney, William Sony Corporation  
CHAN, YEE Facebook  
Cheng, Paul MediaTek Inc.  
CHERIAN, GEORGE Qualcomm Incorporated  
Das, Dibakar Intel Corporation  
Fang, Yonggang ZTE TX Inc  
Fischer, Matthew Broadcom Corporation  
Gan, Ming Huawei Technologies Co., Ltd  
Ghosh, Chittabrata Intel Corporation  
Guo, Yuchen Huawei Technologies Co., Ltd  
Gwak, Yongsu Korea National University of Transportation  
Hamilton, Mark Ruckus/CommScope  
Han, Zhiqiang ZTE Corporation  
Ho, Duncan Qualcomm Incorporated  
Hsu, Chien-Fang MediaTek Inc.  
Hu, Chunyu Facebook  
Huang, Guogang Huawei  
Jang, Insun LG ELECTRONICS  
Jung, hyojin Hyundai Motor Company  
Kakani, Naveen Qualcomm Incorporated  
Kandala, Srinivas SAMSUNG  
Kim, Jeongki LG ELECTRONICS  
kim, namyeong LG ELECTRONICS  
Kim, Sang Gook LG ELECTRONICS  
Kneckt, Jarkko Apple, Inc.  
Kondo, Yoshihisa Advanced Telecommunications Research Institute International (ATR)  
Kwon, Young Hoon NXP Semiconductors  
Lalam, Massinissa SAGEMCOM BROADBAND SAS  
Lan, Zhou Broadcom Corporation  
Li, Yiqing Huawei Technologies Co. Ltd  
Li, Yunbo Huawei Technologies Co., Ltd  
Lv, kaiying MediaTek Inc.  
Monajemi, Pooya Cisco Systems, Inc.  
Omar, Hassan Huawei Technologies Co.,  Ltd  
Ouchi, Masatomo Canon  
Park, Minyoung Intel Corporation  
Park, Sung-jin LG ELECTRONICS  
Patil, Abhishek Qualcomm Incorporated  
Patwardhan, Gaurav Hewlett Packard Enterprise  
Raissinia, Alireza Qualcomm Incorporated  
Rosdahl, Jon Qualcomm Technologies, Inc.  
Seok, Yongho MediaTek Inc.  
Song, Taewon LG ELECTRONICS  
Sun, Li-Hsiang InterDigital, Inc.  
Sun, Yanjun Qualcomm Incorporated  
Torab Jahromi, Payam Facebook  
Wang, Huizhao Quantenna Communications, Inc.  
Wang, Lei Huawei R&D USA  
Wang, Xiaofei InterDigital, Inc.  
Xin, Liangxiao Sony Corporation  
Yano, Kazuto Advanced Telecommunications Research Institute International (ATR)  
Yee, James MediaTek Inc.  
yi, yongjiang Futurewei Technologies  
Yukawa, Mitsuyoshi Canon, Inc.  
Zhou, Yifan Huawei Technologies Co., Ltd

1. **The chair goes through new SP guideline which is described at the end of the agenda (Guideline section)**
   * Summary: Can be found in 11-20/425r21
     1. If a member cannot cast the vote via the pop-up window then the member must notify the chair of such an issue and then can cast his vote in the chat window (and subsequently send an e-mail to the chair). The vote then will be accounted for by the chair (and secretary) when declaring the results.
   * **C: This applis future SPs or affects the old straw polls?**
   * **A:Future SPs**
2. The Chair reminds that the agenda can be found in 11-20/425r21. Today we will go through submissions related to ML-Constrained Ops.

* Technical Submissions:
  + 329r1 Group addressed frame transmission in constrained multi-link operation (Yongho Seok) (only Q&A)
  + 414r0 Method for Handling Constrained MLD (Insun Jang)
  + [415r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-00-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx) Multi-link Aggregation: Synchronized PPDUs on Multiple Links (Insun Jang)
  + [433r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-00-00be-ppdu-alignment-in-str-constrained-multi-link.pptx) PPDU alignment in STR constrained multi-link (Yunbo Li)
  + [444r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0444-00-00be-mla-non-str-sta-edca-rules-after-self-interference.pptx) MLA: Non-STR STA EDCA rules after self-interference (Duncan Ho)
  + [455r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-00-00be-async-mlo-with-non-str-sta.pptx) Async multi-link operation for non-STR STA (Dmitry Akhmetov)
  + [487r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-00-00be-multiple-link-operation-follow-up.pptx) Multiple link operation follow up (Liwen Chu)
  + [490r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0490-00-00be-multi-link-hidden-terminal.pptx) Impact\_of\_channel\_blindness\_ML\_txrx (Dibakar Das)
  + There were serveral discussion on handling deferred SPs and new SPs included in new presentations.
    - Alfred recommended to request SP through e-mail and upload the document including the SPs 24 hours ago so that other people can go through or check the SP texts

**Submissions**

1. [329r](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-00-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx)1 Group addressed frame transmission in constrained multi-link operation (Yongho Seok) (only Q&A)

Discusson: No discussion for Q&A.

Discussion on SP

A: I like to run the Straw poll because of no comment.

C: we will go through the presentation and run the all SPs.

SP is deferred.

1. [414r](https://mentor.ieee.org/802.11/dcn/20/11-20-0414-00-00be-method-for-handling-constrained-mld.pptx)2 Method for Handling Constrained MLD (Insun Jang)

Summary:

Dicussion:

C: how is the primary link concept working?

A: You mentioned non-AP MLD side is primary link ?

C: what is the difference between primary channel and primary link concept?

A: The primary link is way to the access EDCA only. Non-AP MLD does not perform the channel access using EDCA.

C: STA chooses which is primary link? Negotiation between AP and STA or decided by STA.

A: non-AP MLD requests the primary link and AP MLD responds it

C: Trigger frame is sent by STA, Right?

A: Yes non-AP STA

C: Then response is from AP MLD

A: Yes

C: slide 7, here link 1 is primary, that means the STA1 performs EDCA only for STA1.

A: Typo. Remove it.

C: Is it also for reception side of non-AP STA?

A: EDCA is peformed only in the primary link but Trigger based can be performed on non-primary link.

C: primary link is assigned by AP or decided by non-AP?

A: For now, non-AP decision

C: Then it can switch the primary link any time. Right?

1. [415r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-00-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx) Multi-link Aggregation: Synchronized PPDUs on Multiple Links (Insun Jang)

Summary:

Dicussion: Zhou, Jonghun, Rojan, Pooya, chunyu, dimitry, laurent, Yonggang,

C: UL aggregation is aligned with ours. This MLO not only improves throughput but also improves the latency performance as well for UL direction.

C: about immediate aggregation capability why we have to have this capability?

A: for ack case? Right? If link1 has mpdu 1, 2, 3 …

….

C: Thank you for UL access approach. We can work together.

C: What do you meam those time critical information that need to be shared among STAs?

A: TBD information can be implementation issues such as PHY/MAC status or acknowledgement. There are many information it shared within MLD.

C: The capability is peer of STAs or MLD capability?

A: This is not MLD level but STA level.

C: Ok

C: You’re proposing new frame sequence or signaling mechanism like modify the RTS/CTS.

A: we did not define the frame sequence, I focus on generalizing the sharing mechanism.

C: Another question, next slide 7, that is allowed to regulatory or not? On link2, AP does not do regular EDCA back off but just check PIFS.

A: I don’t know exactly the regulatory of it.

Chair: don’t discuss about the regulatory. We already done.

1. 433r1 PPDU alignment in STR constrained multi-link (Yunbo Li)

Summary:

Dicussion:

C: CCA or NAV check if the bit is set. How likely this will happen? The CCA is not tested at all. Only testing the NAV ….

A: I think whether it’s useful, it depends on the current rule in single link…. I think that’s same.

C: … about the non-STR STA. on the STA side there are strong interference from link2. Leakage from link2 to link1 already trigger EDCA on link 1…

A: I don’t agree with your argument. The intention is to solve this leakage here.

C: Your analysis is nice. This is not the corner case, what do you think about the a mount time of Rx/Tx?

A: Totally it’s implementation value.

C: why do we need to have the separate requirement? Why not having one?

A: The reason that aligned this two separate PPDU …

C: I understand the reason. Why do we have two different requirements?

1. 444r1 MLA: Non-STR STA EDCA rules after self-interference (Duncan Ho)

Summary:

Dicussion:

C: option 1, aPPDUMaxTime is 5ms. longer time than TXOP limit. Why do you set the timer to aPPDUMaxTime?

A: It’s not exceeding the limit.

C: Why don’t we reuse the same legacy timer instead of defining new timer?

A: is that NAVsync operation?

C: Yes. STA is power saving mode. … Just reuse the same thing.

A: It’s similar to power saving.

C: we can reuse that instead of new value.

C: slide 4, concern on aPPDUMaxTime. STA1 still contends the channel. STA1 has high probability to win competing to STA2.

A: This is in the same MLD…..

C: How often is switched from STA1 to STA2?

A: That depends on the traffic.

C: But aPPDUmaxtime is super long.

C: Option 2. only solves a certain scenario. not cover all the cases. Maybe hidden node case.

A: That’s true. This is simple operation.

**The meeting was adjourned at 22:00**

**Monday 13 April 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:00 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The Webex app indicates about 101 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Name | Affiliation |
| Aboulmagd, Osama | Huawei Technologies Co.,  Ltd |
| Adachi, Tomoko | TOSHIBA Corporation |
| Adhikari, Shubhodeep | Broadcom Corporation |
| Akhmetov, Dmitry | Intel Corporation |
| Andersdotter, Amelia | None - Self-funded |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Au, Kwok Shum | Huawei Technologies Co., Ltd |
| Bei, Jianwei | NXP Semiconductors |
| Cavalcanti, Dave | Intel Corporation |
| CHAN, YEE | Facebook |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Das, Subir | Perspecta Labs Inc. |
| de Vegt, Rolf | Qualcomm Incorporated |
| Dong, Xiandong | Xiaomi Inc. |
| Fang, Yonggang | ZTE TX Inc |
| Fischer, Matthew | Broadcom Corporation |
| Gan, Ming | Huawei Technologies Co., Ltd |
| Garg, Lalit | Broadcom Corporation |
| Ghosh, Chittabrata | Intel Corporation |
| Guo, Qiang | Futurewei Technologies |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Hamilton, Mark | Ruckus/CommScope |
| Han, Jonghun | SAMSUNG |
| Han, Zhiqiang | ZTE Corporation |
| Hervieu, Lili | Cable Television Laboratories Inc. (CableLabs) |
| Ho, Duncan | Qualcomm Incorporated |
| Hsu, Chien-Fang | MediaTek Inc. |
| Hu, Chunyu | Facebook |
| Huang, Guogang | Huawei |
| Huang, Po-Kai | Intel Corporation |
| Hwang, Sung Hyun | Electronics and Telecommunications Research Institute (ETRI) |
| Jang, Insun | LG ELECTRONICS |
| Jiang, Jinjing | Apple, Inc. |
| Jung, hyojin | Hyundai Motor Company |
| Kain, Carl | USDoT |
| Kakani, Naveen | Qualcomm Incorporated |
| Kandala, Srinivas | SAMSUNG |
| Kim, Jeongki | LG ELECTRONICS |
| kim, namyeong | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Yongho | Korea National University of Transportation |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Kneckt, Jarkko | Apple, Inc. |
| Ko, Geonjung | WILUS Inc. |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Lan, Zhou | Broadcom Corporation |
| Lansford, James | Qualcomm Incorporated |
| Levy, Joseph | InterDigital, Inc. |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Lv, kaiying | MediaTek Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Nezou, Patrice | Canon Research Centre France |
| Ouchi, Masatomo | Canon |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Raissinia, Alireza | Qualcomm Incorporated |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Stacey, Robert | Intel Corporation |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Tanaka, Yusuke | Sony Corporation |
| Verma, Sindhu | Broadcom Corporation |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| ZHANG, JIAYIN | HUAWEI |

1. The Chair reminds that the agenda can be found in 11-20/425r23.
   * Technical Submissions – ML Constained ops.
     + [455r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-00-00be-async-mlo-with-non-str-sta.pptx) Async multi-link operation for non-STR STA (Dmitry Akhmetov)
     + [487r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-00-00be-multiple-link-operation-follow-up.pptx) Multiple link operation follow up (Liwen Chu)
     + [490r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0490-00-00be-multi-link-hidden-terminal.pptx) Impact\_of\_channel\_blindness\_ML\_txrx (Dibakar Das)
     + Deferred SPs on ML-Constrained ops
       - …
   * Discussion on this agenda.
     + There were a request to add a new contribution to this ML Constrained OPs and several related discussions.

**Submissions**

1. 455r1 Async multi-link operation for non-STR STA (Dmitry Akhmetov)

**Summary:**

* Traffic separation enable traffic in both directions in case of DL/UL mix for all observed configurations in isolated 1 AP 1 STA case
* PPDU end alignment enable nAP/iSTA case and improve UL throughput in iAP/iSTA case
* Amount of shared information/level of AP/STA integration greatly affect results and need to be explicitly considered/mentioned in behavior analysis
* JMPC work only in one case – when devices have full information and able to grab medium at the same time

**Discussion:**

C: the STR STA and non-STR AP are related to non-AP device. It means that STA side should consider both STR case and non-STR case?

A: Yes, AP has non-constraints

C: the UL and DL is 0.1 and 0.1.

A: DL and UL are equal for period case.

C: But on one of slides you mentioned DL traffic is majority and UL traffic is less. You decided the other configuration there?

A: I don’t see any major difference on results.

C: This is simulation. In real environment, I think DL and UL traffic is pretty dynamic. …

A: I agree with the scope. …

C: In R1, you want to put the integrated solution or non-integrated solution?

A: No, here we don’t mention that. Here focus on the constraints. AP is not constraints. STA is constraints or not constraints.

C: SP 3, I don’t see in your contribution the power states. What do you think?

C: slide 11, Why does the STA has better intergration than AP?

A: AP is more complex deivce. It cares about multiple STAs.

C: My previous thing was AP is more powerful than STA.

C: about a lot of application, it’s very difficult to predict the traffic separation for DL/UL. Some of UL protocol, … based on the result of DL traffic like TCP Ack. …. For mobile device, newly become few streams …

A: I did not do that level of the details, we studied how we could be done.

1. [487r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-00-00be-multiple-link-operation-follow-up.pptx) Multiple link operation follow up (Liwen Chu)

**Summary:**

* The simultaneous transmission in two links through backoff in one link and enhanced PIFS idle/busy check in another link is allowed.
* When STA MLD (simplified text of link1 STA affiliated with STA MLD) finishes backoff in one link, the STA MLD starts the normal frame exchanges and ask AP MLD help of synchronized transmission if possible

**Discussion:**

C: slide 4, this length is in bytes or duration?

A: It’s just PPDU length. If the bytes, this length depends on the PPDU bandwidth or MCSs.

A: PPDU length is microseconds.

C: You said IFS is longer than SIFS and no more than PIFS. What’s that?

C: You got a lot of topic. … at non-STR really looking at DL aggregation focus. Another. Have you done the evaluation on this …going to PIFS access solution compared to AP-assisted?

A: This AP assisted simultaneous transmission still need more work to do. That is not easy to us. PIFS works. This is under debated I assume.

C: slide 4, do you know the regulatory constraints?

A: No regulation issue. We only do that baseline.

C: Going to link1, basically, QoS Null + ACK

A: This one I shouldn’t change. Forget it. This is not related to do this solution.

….

C: PIFS recovery is ok with that. But there is no gain. We should be open for this padding or PPDU alignment.

C: slide 8, one link fails.

A: This is two link fails.

C: Next slide, you’re allowing the recovery beyond the PIFS …

A: This is baseline recovery

1. [490r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0490-00-00be-multi-link-hidden-terminal.pptx) Impact\_of\_channel\_blindness\_ML\_txrx (Dibakar Das)

**Summary:**

* Doing something to prevent an EHT STA MLD from self-blocking itself (due to failed RTS transmissions) can improve EHT STA MLD performance.
* Option 1: Following a transmission on a link, non-STR EHT STA MLD refrains from transmitting any packet on the other link similar to the NAVsyncdelay timer behavior as it is similar to STA coming out of Doze.
* Option 2: AP transmits cross-link information in a DL frame (e.g., BA) signaling whether it is transmitting or receiving packets on the other link and/or its NAV duration on the other link.

**Discussion:**

C: Option 1 would be the simplest way. this timer is too high then the channel ...… constrainted device that can have the core time have significant time . … We’re thinking that could be like melt down within two options ….

A: I will think of it more. Option 2, what it has to be signaling from the AP, STA may transmit something on link 1 and it collide with something.

C: Duncun already had a presentation at the last call. … maybe we can use that anyway. … some signaling delay time what were, if AP don’t go … MLD detection is much helpful.

A: thank you

C:slide 3, In this diagram, RTS/CTS on link 3 is overlapping with data frame on link 1

A: maybe link 2

C: the first MLD only has two STAs then RTS/CTS is overlapping with what transmitting on link 1. There could be possible. RTS/CTS on link 2 is overlapping with RTS/CTS transmitted on link 1. …

A: It’s the same MLD just transmits the two things .

…..

C: OK, the second RTS CTS is needed?

A: It’s implementation, AP can decide

C: I’m not certain that there is enough traffic mixed there. …

A: If you have mixed DL and UL, I think that’s the corner case here the problem comes from the hidden node issue. We can consider other scenario, ...

…

C: Option 2, we’re aligned that it may be in R2. For option 1, if we could add lower ED level. … -82dbm ED threshold for option 1?

A: … -82dbm does not transmit anything. … something happening in -62 to -82. What do you do in that false alarm thing?

C: -82 false alarm is depending on the scenarios

A: Yes, … We can see the throughput what the false alarm happen?

**The meeting was adjourned at 22:00**

**Friday, April 17, 2020, 10:00 – 13:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The Webex app indicates about 103 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Adhikari, Shubhodeep | Broadcom Corporation |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Baik, Eugene | Qualcomm Incorporated |
| baron, stephane | Canon Research Centre France |
| Ben Arie, Yaron | toga networks(a huawei company) |
| Bredewoud, Albert | Broadcom Corporation |
| Carney, William | Sony Corporation |
| Chen, Xiaogang | Intel |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Choi, Jinsoo | LG ELECTRONICS |
| Das, Subir | Perspecta Labs Inc. |
| da Silva, Claudio | Intel Corporation |
| Derham, Thomas | Broadcom Corporation |
| de Vegt, Rolf | Qualcomm Incorporated |
| ElSherif, Ahmed | Qualcomm Incorporated |
| Fang, Yonggang | ZTE TX Inc |
| Gan, Ming | Huawei Technologies Co., Ltd |
| Ghosh, Chittabrata | Intel Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Han, Jonghun | SAMSUNG |
| Han, Zhiqiang | ZTE Corporation |
| Handte, Thomas | Sony Corporation |
| Hervieu, Lili | Cable Television Laboratories Inc. (CableLabs) |
| Ho, Duncan | Qualcomm Incorporated |
| Hong, Hanseul | Yonsei University |
| Hu, Chunyu | Facebook |
| Huang, Lei | Panasonic Asia Pacific Pte Ltd. |
| Jang, Insun | LG ELECTRONICS |
| Jones, Vincent Knowles IV | Qualcomm Incorporated |
| Kain, Carl | USDoT |
| Kakani, Naveen | Qualcomm Incorporated |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Sanghyun | WILUS Inc |
| Kim, Yongho | Korea National University of Transportation |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lansford, James | Qualcomm Incorporated |
| Levitsky, Ilya | IITP RAS |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Liang, dandan | Huawei Technologies Co., Ltd |
| LIU, CHENCHEN | Huawei Technologies Co., Ltd |
| Lou, Hanqing | InterDigital, Inc. |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Nezou, Patrice | Canon Research Centre France |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Raissinia, Alireza | Qualcomm Incorporated |
| Sedin, Jonas | Ericsson AB |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Stacey, Robert | Intel Corporation |
| Strauch, Paul | Qualcomm Incorporated |
| Sun, Bo | ZTE Corporation |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Torab Jahromi, Payam | Facebook |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wang, Xiaofei | InterDigital, Inc. |
| Ward, Lisa | Rohde & Schwarz |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yu, Jian | Huawei Technologies Co., Ltd |
| Yu, Mao | NXP Semiconductors |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| Zhou, Yifan | Huawei Technologies Co., Ltd |
| Zuo, Xin | Tencent |

1. The Chair reminds that the agenda can be found in 11-20/425r26.

* Technical Submissions-**ML Constrained Ops**:
  + Deferred SPs: [1305r3](https://mentor.ieee.org/802.11/dcn/19/11-19-1305-03-00be-synchronous-multi-link-operation.pptx) (1 SP), [026r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-03-00be-mlo-sync-ppdus.pptx) (2 SPs), [081r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0081-02-00be-mlo-synch-transmission.pptx) (6 SPs), [082r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0082-01-00be-synchronous-transmitter-medium-state-information.pptx) (7 SPs), [188r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0188-01-00be-multi-link-triggered-uplink-access.pptx) (1 SP), [291r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0291-01-00be-mlo-async-and-sync-operation-discussion.pptx) (1 SP), [329r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-02-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx) (2 SPs), [414r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0414-03-00be-method-for-handling-constrained-mld.pptx) (1 SP), [415r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-03-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx) (2 SPs), [455r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-01-00be-async-mlo-with-non-str-sta.pptx) (4 SPs), [487r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-02-00be-multiple-link-operation-follow-up.pptx) (4 SPs)
* Technical Submissions: **ML-Block Ack**
  + [0012r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0012-00-00be-multi-link-acknowledgement-follow-up.pptx) Multi-link Acknowledgement Follow Up (Taewon Song)
  + [0024r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0024-00-00be-mlo-acknowledgement-procedure.pptx) MLO: Acknowledgement procedure (Abhishek Patil)
  + [0053r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0053-00-00be-multi-link-ba.pptx) Multi-link BA (Po-Kai Huang)
  + [0055r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0055-00-00be-multi-link-block-ack-architecture.pptx) Multi-link block ack architecture (Rojan Chitrakar)
  + [0122r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0122-00-00be-a-bar-variant-for-multi-link-operation.pptx) A BAR Variant For Multi-Link Operation (Chunyu Hu)
  + [432r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0432-00-00be-bug-fix-for-acknowledgement-rule-in-multi-link.pptx) Bug fix for Acknowledgement rule in multi-link (Yunbo Li)
  + [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho)
  + 448r0 Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)
  + [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)

**Discussion:**

C: 1547r4 was missed in the SP list

C: 433r3 multi-link contraints,

C: One (STR and non-STR) is about multi-link definition.

A: I think that should be in ML architecture.

C: Do you want to finish all SP firstly and go to presentation?

A: Yes,

C: SP can be run after the presentation was made.

A: Sound good.

C: What’s number?

A: 69r2

C: Regarding, do you have time limitation on SP? Is there any guideline on SP?

A: Yes, no more than 10 minutes.

C: Got it.

**Submissions**

1. [1305r3](https://mentor.ieee.org/802.11/dcn/19/11-19-1305-03-00be-synchronous-multi-link-operation.pptx), Synchronous Multi-link Operation (Yongho Seok) for only SP1

* **SP1: Do you support the following PPDU transmission restriction for the constrained multi-link operation?** 
  + If an AP MLD intends to align the ending time of DL PPDUs carrying a frame soliciting an immediate response simultaneously sent to the same non-STR non-AP MLD on multiple links, the AP MLD shall ensure that the difference between the ending times of transmitting DL PPDUs is less than TBD (< SIFS).
    - Where the reference of the ending time of the PPDU is TBD.

Discussion:

C: I sent e-mail through e-mail reflector. I’m not sure you’re checked.you’re one SP looks more clean.

A: I think yours is a little detailed. Mine is simple and general.

C: We can merge this with mine.

A: If your SP is passed, i think we can merge the related texts to one.

C: Does this immediate response contain both ack/ba and TB PPDU?

A: Yes. This includes both them.

C: It could be multiple value depending on scenarios.

C: Just small minor change. Change STA to non-AP.

A: Non-STR non-AP MLD.

C: AP MLD intends to align the ending time of... If we don’t have this clarification, is there any problem? What’s the problem? Is there any case that AP should align the ending time except for this case?

A: No

C: Do we need to limit this to AP MLD?

A: Yes. we can use the current rule for Non-AP MLD.

Result: 50 Yes/4 No/35Abstain/10 No answer

1. [026r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-03-00be-mlo-sync-ppdus.pptx), MLO: Sync PPDUs (Duncun) only for SP

Disucssion:

SP 1: Do you agree to the following?

* In R1 of the spec, supporting the following cases:
  + STR AP NLD with STR non-AP MLD
  + STR AP MLD with non-STR non-AP MLD
  + Note: All the other cases are TBD.

C: What means focus on? need to delete focus on.

A: Yes

C: remove the at least.

C: I think the original text is clear to me.

C: do you want to exclude other cases?

A: This does not say that other cases are excluding.

C: My suggestion is adding to all other cases are TBD

C: All other cases are TBD what does it mean? Text is not clear to me. If you adding 3rd bullet, I’m confusing.

C: Change it to Note.

C: the revision is R4.

Results: 71 Yes/3 NO/ 15 Abstain

SP2 Do you agree to the following?

* An STR AP MLD shall align the end of DL PPDUs that are sent simultaneously on multiple links to the same non-STR non-AP MLD, in such a way that the response to any of the PPDUs will not overlap with any of the DL PPDUs?

Discussion:

C: I think the capapbility indication is much better overall.

A: When I presented, many people wants to mandate this for AP

C: This means always AP shall ….? This is not flexible for AP operation. Capability indication is much good to me.

C: For AP operation, always or not?

Chair: Don’t repeat.

C: Do we have terminology STR or non-STR? No in SFD?

C: What is the difference between this and yongho’s SP?

A: For yongho’s, AP intends to…

C: This is always “shall”

Chair: Don’t repeat the same question.

C: Yonggang, I think we need to define the terminologies of STR /non-STR clearly.

C: The last part may be redundant with Yongho’s

A: I’d like to run other SP instead of this. I can change the wording.

C: Just run the SP. It’s up to you.

Results: 41 Yes/35 No/17 Abstain,

1. [081r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0081-02-00be-mlo-synch-transmission.pptx), MLO-Synch-Transmission (Matt) only for SP

SP 2:

* **Do you support the inclusion of the following in the SFD:**
  + 802.11be shall define a trigger message that may be transmitted by an AP or a non-AP STA and elicits an SU PPDU, for example, as a means to assist in creating an alignment of PPDU start and or end times on different links

Discussion:

C: Is this optional or mandate?

A: It’s optional?

C: For Non-AP STA, RDP is enough?

A: No, we need some modification for it.

C: do you want to make new message?

A: It’s TBD. It’s just concept.

C: Goerge, both Trigger frames is sent simultaneous on both links?

A It’s very simple extension.

C: Trigger message is transmitted by EDCA?

A: No, it’s transmitter’s decision.

C: It’s too broad.

C: Why do you add “ and or” ?

…

Chair: No more question. If you…

C: my suggestion is to remove the trigger. Just message.

C: lower case trigger is just concept.

A: Reminder. It’s so simple approach.

Results: 32 Yes/36 No/24 Abstain/11 No answer

1. [082r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0082-01-00be-synchronous-transmitter-medium-state-information.pptx), Synchronous-Transmitter-Medium-State-Information (Matt) only for SP

SP0:

* **Do you support the inclusion of the following in the SFD:**
  + 802.11be shall include a mechanism for the exchange of Medium State Information and rules for the use of that information by an NSTR STA

Discussion:

C: One concern is it does not care about OBSS.

A: Was a lot of discussion. 0 OBSS.

C: There are many different solution. It’s too early to run SP. Need more disucsion.

A: This is general concept and high level.

C: A little bit early to decide the solution.

C: Same as previous. Should be more discussion

C: is it non-AP or AP?

A: No restriction.

C: Do you think this in R1 or R2?

A: Not easy in R1

C: It could be in preamble? It should be short frame.

A: Just 1 bit in phy header.

The revision will be R2.

Results: 28 Yes/38 No/29Abstain/10 No answer

Other SP?

No

1. [188r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0188-01-00be-multi-link-triggered-uplink-access.pptx), Multi-link Triggered Uplink Access, Yongho Seok

Discussion: I want to move this after Yunbo. Can I change the order? What is the number? It’s 433.

This SP is defered

1. [291r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0291-01-00be-mlo-async-and-sync-operation-discussion.pptx), MLO Async. and Sync. Operation Discussion

SP2:

* + - Do you agree a mode of MLO operation that supports NON STR NON AP MLD to initiate transmit and receive frames to a NON STR AP MLD concurrently (PPDUs on multiple links overlapping in time domain) on multiple available links and solicit response is not in the scope of R1. Note-whether to define NON STR AP MLD is TBD
    - YES
    - NO
    - ABS

C: I think that transmit and receive. Right?

A: Fine.

C: …

A: There should be a procedure for …

C: I agree we should prioritize the …. We can have simple solution.

C: why don’t you in R1?

C: It’s not easy to decide in R1/R2.

A: for non-STR AP MLD, single link MLO could be in R1?

C: STR AP is static or dynamic capability?

A: …

C: General, Good SP

C: Do we need to define Non-STR AP? Or it could be defined in R2?

A: I agree. We don’t need to define it.

C: If passed, do we define non-STR AP? It doesn’t mean we define non-STR AP.

A: Adding note.

Results: 39 Yes/29 No/22Abstain/14 no answer

1. [329r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-02-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx), Group addressed frame transmission in constrained multi-link operation

* SP1: Do you support the following group addressed frames delivery mechanism?

The non-STR STA MLD may configure one link with the AP MLD to receive group addressed frames, then during the group addressed delivery in the configured link, then the AP MLD may not schedule frames soliciting an immediate response to this non-STR STA MLD on other links that overlap with group address frame. NOTE- The condition to signal the configured link is TBD.

Discussion:

A: I’m not proposing the group addressed frames in a single link.

C: multicast and broadcast message can be received in a link

A: It may be possible.

C: In the last sentence, AP MLD …. Is for non-STR STA MLD?

A: Yes, I’ll add.

C: AP perspective, you can dupliciate in the links.

C: STA side, AP wants to do that? Can you add the note of it? Whether to have signaling of non-STR STA MLD to AP MLD about link mornitoring is TBD

C: AP may or may not have dupliciation frames in multiple links.

A: You mean the conditions?

C: Non-AP MLD

C: may not schedule frame means any frame? It does not solicit frame.

C: This is not restricting the link to receive the frame.

A: STA may change the configured link.

The revision will be R3.

Results: 36 Yes/21 No/35 Abstain

1. [414r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0414-03-00be-method-for-handling-constrained-mld.pptx), Method for Handling Constrained MLD

SP1:

Do you agree that 11be shall define mechanism(s) for enabling a non-AP MLD with constraints to transmit PPDUs overlapping on multiple links?NOTE: whether it is for R1 or R2 is TBD.

Discussion:

C: what does it mean ”the PPDUs overlapping on multiple links”? PHY layer or MAC layer? PPDU is PHY concept.

A: This is what PPDU in time domain

C: Overlapping PPDU is in time domain.

A: Yes

C: two independent PPDUs in multiple links align somehow.

A: The channel access can be suspended on the other link due to the traffic interference. I proposed the method. The detailed methods are open.

C: overlapping PPDU is initiating frame or response frame?

A: not included in the frame exchange sequence. This is just non-AP MLD side which can transmit the overlapping PPDUs.

C: enabling the non-AP MLD with constraints means non-STR?

A: Yes,

C: transmitting overlapping PPDUs means alignment or non-alignment?

A: This is the alignment.

C: SP text is too broad and... complex solution should be ... in R1. For first comment, you need to modify the text that explicitly mentions if it’s R1 or R2.

C: If this is only for R2, why we should write here?

C: I prefer original SP. Now I’m so confusing. why we should use this in R2?

Results: 37 Yes/27 No/24 Abstain

1. [415r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-03-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx), Multi-link Aggregation: Synchronized PPDUs on Multiple Links

**Do you agree that 11be shall allow the following multi-link operation?**

* 1. When at least one STA of non-AP MLD with constraints transmits a PPDU, the other STA(s) in the non-AP MLD defers (defer) the channel access without performing CCA during the transmission of PPDU

Discussion:

C: Do you say that when one of them is transmitting, the other would not back off or nothing?

A: Yes

C: This is more implementation. One STA on one link starts the transmission in constrained MLD then the back off on the other link will be suspended anyway.

C: Even if CCA is performed on the certain link, the back off is suspended.

A: We can have whether the STA defers the channel access is or not is the implementation issue?

C: Right. ... For some implementation, One is explicitly to stop the CCA procedure. Other mechanism is that the CCA is peformed and the back off is suspeneded.

A: for non-STR non-AP MLD, We don’t need to access the channel. why we transmit on the link?

C: same as Zhou, Second is what is the other STA? Other STAs in the same non-AP MLD? Can you write that?

A: Yes

C: if the leakage is less than ED level, the STA can perform the CCA. In this case the STA shall not defer the channel access.

Results: 12 Yes/52 No/22 Abstain

**The meeting was adjourned at 13:00**

**Monday, April 20, 2020, 10:00 – 13:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * The Webex app indicates about 91 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Abouelseoud, Mohamed | Sony Corporation |
| Aboulmagd, Osama | Huawei Technologies Co.,  Ltd |
| Adhikari, Shubhodeep | Broadcom Corporation |
| Akhmetov, Dmitry | Intel Corporation |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Bei, Jianwei | NXP Semiconductors |
| Bredewoud, Albert | Broadcom Corporation |
| Carney, William | Sony Corporation |
| CHAN, YEE | Facebook |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Coffey, John | Realtek Semiconductor Corp. |
| Das, Subir | Perspecta Labs Inc. |
| de Vegt, Rolf | Qualcomm Incorporated |
| Fischer, Matthew | Broadcom Corporation |
| Garg, Lalit | Broadcom Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Hamilton, Mark | Ruckus/CommScope |
| Han, Jonghun | SAMSUNG |
| Han, Zhiqiang | ZTE Corporation |
| Ho, Duncan | Qualcomm Incorporated |
| Hong, Hanseul | Yonsei University |
| Huang, Guogang | Huawei |
| Jang, Insun | LG ELECTRONICS |
| Kakani, Naveen | Qualcomm Incorporated |
| Kim, Jeongki | LG ELECTRONICS |
| kim, namyeong | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Yongho | Korea National University of Transportation |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kumar, Manish | Marvell Semiconductor, Inc. |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Levy, Joseph | InterDigital, Inc. |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Lv, kaiying | MediaTek Inc. |
| Max, Sebastian | Ericsson AB |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Nezou, Patrice | Canon Research Centre France |
| Park, Minyoung | Intel Corporation |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Raissinia, Alireza | Qualcomm Incorporated |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Stacey, Robert | Intel Corporation |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Torab Jahromi, Payam | Facebook |
| Verma, Sindhu | Broadcom Corporation |
| VIGER, Pascal | Canon Research Centre France |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wentink, Menzo | Qualcomm |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Zeleznikar, Alan | CommScope |
| Zhou, Yifan | Huawei Technologies Co., Ltd |
| Zuo, Xin | Tencent |

1. The Chair reminds that the agenda can be found in 11-20/425r26.
2. Technical Submissions-**ML Constrained Ops**:
   * Deferred SPs: [1547r3](https://mentor.ieee.org/802.11/dcn/19/11-19-1547-03-00be-multi-link-operation-and-channel-access-discussion.pptx) (4 SPs), [26r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-04-00be-mlo-sync-ppdus.pptx) (1 SP), [069r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0069-02-00be-multi-link-communication-mode-definition.pptx) (2 SPs), [188r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0188-01-00be-multi-link-triggered-uplink-access.pptx) (1 SP), [433r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-03-00be-ppdu-alignment-in-str-constrained-multi-link.pptx) (1 SP), [455r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-01-00be-async-mlo-with-non-str-sta.pptx) (4 SPs), [487r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-02-00be-multiple-link-operation-follow-up.pptx) (4 SPs)
3. Technical Submissions: **ML-Block Ack**
   * [0012r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0012-00-00be-multi-link-acknowledgement-follow-up.pptx) Multi-link Acknowledgement Follow Up (Taewon Song)
   * [0024r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0024-00-00be-mlo-acknowledgement-procedure.pptx) MLO: Acknowledgement procedure (Abhishek Patil)
   * [0053r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0053-00-00be-multi-link-ba.pptx) Multi-link BA (Po-Kai Huang)
   * [0055r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0055-00-00be-multi-link-block-ack-architecture.pptx) Multi-link block ack architecture (Rojan Chitrakar)
   * [0122r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0122-00-00be-a-bar-variant-for-multi-link-operation.pptx) A BAR Variant For Multi-Link Operation (Chunyu Hu)
   * [432r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0432-00-00be-bug-fix-for-acknowledgement-rule-in-multi-link.pptx) Bug fix for Acknowledgement rule in multi-link (Yunbo Li)
   * [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho)
   * [448r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0448-00-00be-multi-link-ba-bitmap-parsing-rule.pptx) Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)
   * [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)

C: One of SPs in 415r4 was not run at the last meeting. Could you add it in the agenda?

A: Last CC, last presentation?

C: Yes.

No further discussion. Agenda is approved.

**Submissions**

1. [415r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0415-03-00be-multi-link-aggregation-synchronized-ppdus-on-multiple-links.pptx), Multi-link Aggregation: Synchronized PPDUs on Multiple Links, Insun Jang (LG Electronics) Only SP

**SP#2 of r4: Do you agree that an MLD can inform a peer MLD of the capability of whether STAs of the MLD can exchange the information?**

Discussion:

C: Do you mean immediate or instanstly?

A: the timing of sharing is implementation issue. I didn’t add the timing contents.

C: What is the main purpose of this capability if no timing?

A: This is the high level concept. At next time we can define the timing or what information is needed for the sharing.

C: STAs of MLD exchange a lot of information. Need the capability of the specific some information.

C: what is the information here? Very weak and very broad.

A: Let me defer this SP.

SP is deferred

1. [1547r](https://mentor.ieee.org/802.11/dcn/19/11-19-1547-03-00be-multi-link-operation-and-channel-access-discussion.pptx)4, Multi-link-operation-and-channel-access-discussion , Kaiying Lu (Mediatek Inc.) on SP

**SP1 of r5: Do you support that an AP MLD may transmit Beacon only on a subset of multiple links?eg. Transmit Beacon on one link of a pair of linksHow to choose the link to transmit Beacon is TBD.Note: when the AP MLD has TX/RX constraints.**

Discussion:

C: R4 is not in the server.

A: Just SP text is changed but not change the main text.

C: it would be good to get the Beacon on all the links. What is the reason that Beacon is not on all the links?

A: One reason is AP MLD has a constrants and it want to control the channel access…

C: Then, add the information

A: Suggest to add a note. Any suggestion?

C: Add the note when the AP has constraints.

C: I don’t think that’s good idea to do that. you focus on more non-STR AP. I don’t think it’s needed in that scenarios. …

C: I’d like to clarify whether the AP MLD is constraints MLD but you already added this. I support this SP.

C: it’s better in R2 in stead of R1

**Yes/No/Abstain/No answer: 26/34/13/8**

* SP2 of r5: Do you support that an AP MLD is capable to enable or disable a contention based channel access for each STA within a non-AP MLD?

Discussion;

C: Is this related to also non-STR AP?

A: Yes. I can add some note if people want

C: In 11ax we already have the capability for AP to temporally disable the non-AP STA use EDCA … do you want still something on top of the existing things?

…

C: What is the difference between this constrained AP and the legacy 80+80 channel access?

C: It can affect the something like latency

C: We need to be careful, I don’t think this is good direction.

A: AP MLD is smart. It just the best effort. I think it works.

Yes/No/Abstain/No answer: 28/37/12/5

1. [26r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0026-04-00be-mlo-sync-ppdus.pptx), MLO: Sync PPDUs, Duncan Ho (Qualcomm)

Do you agree to the make the following an optional or mandatory feature?An AP MLD aligns the end of DL PPDUs that are sent simultaneously on multiple links to the same non-STR non-AP MLD, in such a way that the response to any of the PPDUs will not overlap with any of the DL PPDUsMandatory (no signaling needed):29Optional (will need to add capability signaling):6Neither:26

Abstain: 15

No answer: 8

Discussion:

C: the end alignment is just AP decision.

C: The capability is advertised, the AP shall perform the time alignment mentiond above

C: I don’t think the capability is good approach. If the capability is used, the AP may not advertise the capability and the throughput will be degraded.

C: I think this seems like the old SP you run at the last call.

C: What does the mandatory mean? AP shall align all PPDUs …? I’m confusing..

Chair: You go to offline discussion.

C: If you don’t change this, it’s still unclear of this.

Results: 29/6/26/8

1. [069r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0069-02-00be-multi-link-communication-mode-definition.pptx), multi-link communication mode definition, Yonggang Fang (ZTE TX)

**SP1: Do you support to define the following in SFD ?**

* 1. **Non-STR Operation:** A MLD can transmit on one or more links, or receive on one or more links, but not transmit and receive simultaneously.
     1. For example, an MLD not capable of simultaneous Tx/Rx on multiple links can only perform Tx/Tx or Rx/Rx on multiple links.
  2. **STR Operation:** A MLD can transmit on one or more links concurrently with receiving on other link(s).

Discussion:

C: Already passed SP on the capability of non-STR. Why do we define non-STR operation?

C: If STA receives the long …

C: What is the purpose of STR or non-STR? We already have STR meaning that is simultaneously TX and RX. Why do we define the operation?

A: I delete the operation in the text.

C: The capability of STR is appropriate.

A: I just want to use common terminology in the spec.

C: Same as George. STR and non-STR depends on between links not MLD if …

C: if people want to have different opinion, I can defer this.

C: I think STR and non-STR defining is fine but just wording need to clarify

SP is defered

1. 188r2, Multi-link Triggered Uplink Access, Yongho Seok (MediaTek)

SP1: When an AP MLD aligns the ending time of DL PPDUs, the alignment requirement (i.e., the difference restriction between the ending times of transmitting DL PPDUs) is determined independent of the frame contained in the DL PPDUs.

Discussion

C: Firstly, we should move on the next topic

C: Regarding the Trigger frame case, we need only [-4,+4] us alignment.

A: 4us need to be discussed. Other people thinks 8us may be needed like mid-packet detection.

C: For SP1, you have the backup SP. I think this is not aligned. If the different ...

C: I think it’d better have different requirement parameters on each scenarios

Yes/No/Abstain/No Answer: 24/22/29/14

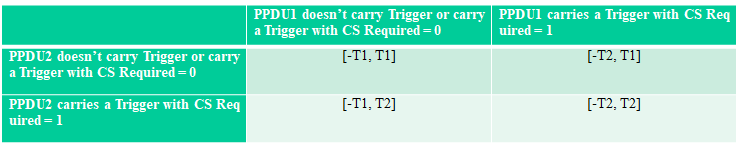
1. [433r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-03-00be-ppdu-alignment-in-str-constrained-multi-link.pptx), PPDU alignment in STR constrained multi-link, Yunbo Li (Huawei)

SP1: Do you support below synchronization requirement?

When a MLD1 transmit PPDU1 and PPDU2 in link 1 and link 2 respectively to a MLD2 which is STR constrained, if PPDU1 and PPDU2 has time domain overlapping, then the offset of ending time of PPDU2 compare with ending time of PPDU1 should follows below table

T1 = SIFS – TBD value;

T2 < T1, and the values of T2 is TBD.



C: alfred, how can I put this table in the poll system? Just mentioning this is based on table on this reference.

A: I’m fine that way.

C: Is there relationship between T1 and T2?

C: You’re saying that the timing is different depending on whether PPDU carries Trigger or not.

C: T1 and T2 is less than SIFS.

C: For T1, TBD can be derived from 10% slot time. For T2, …

C: This is more implementation value. TBD value is uncertained.

A: Finally, spec does not have TBD value but exact value. Here, people have different value of TBD each other. So, Here is tBD

C: T1 is closed to SIFS, T2 is to TX/RX turnaround value. I think for T2, 2us is enough. I think instead of TBD, we need to define the specific value.

A: I prefer to still keep TBD value here. I think it’s too early to decide the exact value.

C: T2 is less than T1. That is what you want.

A: If this passes, we can decide the exact value.

C: No,

C: This is a little better than earlier. Do you want to define two value?

A: Yes.

Yes/No/Abstain/No Answer: 31/11/28/13

1. [455r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0455-01-00be-async-mlo-with-non-str-sta.pptx), Async mlo with non-STR STA, Dmitry Akhmetov (Intel)

**SP2: Do you agree as a part of R1 spec development 802.11be when defining modes of operation with concurrent transmission on multiple links for devices with non-STR capabilities to focus on modes where STR AP MLD is the initiator of such transmission.**

Discussion:

C: Why do you exclude the non-STR STA’s transmission to STR AP?

A: I’m not excluding it. Just focus on DL transmission.

C: What is the complexity or gain of DL transmission on multiple links?

A: I think you showed the gain of simple cases (single AP and single STA).

Chair: We already discussed this issue like complexity and gain. You don’t need to repeate that.

C: I think it’s too early that it’s complex and this will more gain.

C: I support this SP. ...

C: What topic is ...

I’ll defer this SP.

SP2 is defered

SP3:

* **Intro: DL/UL separation can be enabled/controlled today by the STA by using power management mode changes, or power state changes, or availability state change.**
  + As AP MLD will buffer DL BUs when the STA is in doze state/unavailable
* **Do you agree to extend the conditions for which a STA can change its power states/availability states**
  + For example, during a U-APSD service period, being able to go to doze state at any time

Discussion:

C: Is there any thing normative in SP? It can be enabled/controlled today... what exactily ack ?

C: If this mechanism is adopted in U-APSD like VoIP which has lower latency and bi-directional traffic, the latency of DL traffic of VoIP traffic can be increased.

A: I don’t change it. VoIP traffic is 10ms to 30ms. STA may or will block DL in such case. because entire DL of VoIP traffic is single packet, there is nothing to block. ...

...

SP is defered

1. [487r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-02-00be-multiple-link-operation-follow-up.pptx), Multiple Link Operation Follow Up, Liwen Chu (NXP)

* SP1: Do you support that the simultaneous transmission in two links through backoff in one link (link 1) and enhanced PIFS idle/busy check in another link (link 2) is allowed:
  + NAV checking in primary 20MHz channel of link2 besides PIFS checking in other secondary channels of link2,
    - The link2’s following backoff is increased by the suspended backoff counter value.

The further method to guarantee fairness is TBD

Discussion:

C: What is the difference between this SP and thing Duncun try to a few weeks ago?

A: Duncun didn’t not propose PIFS.

C: I agree with this. Wanna clarify the text about ”the link 2’s following backoff ...”. This is one of the methods to gurantee fairness, right?

A: Yes.

C: I think this is to be discussed as you mentioned also the further method to guarantee fairness is TBD.

A: Ok let’s hear more opinion.

C: what do you mean ” following backoff”?

A: Link2 eventually do another backoff. ...

C: This is not clear to me.

SP was not run due to time out

**The meeting was adjourned at 13:00**

**Thursday, 23 April 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * If you are unable to record the attendance via [IMAT](https://imat.ieee.org/attendance) then please send an e-mail to Liwen Chu ([liwen.chu@nxp.com](mailto:liwen.chu@nxp.com)) and Jeongki Kim ([jeongki.kim@lge.com](mailto:jeongki.kim@lge.com))
   * The Webex app indicates about 105 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Aboulmagd, Osama | Huawei Technologies Co.,  Ltd |
| Akhmetov, Dmitry | Intel Corporation |
| An, Song-Haur | INDEPENDENT |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Au, Kwok Shum | Huawei Technologies Co., Ltd |
| Carney, William | Sony Corporation |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Chu, Liwen | NXP Semiconductors |
| Das, Dibakar | Intel Corporation |
| Das, Subir | Perspecta Labs Inc. |
| de Vegt, Rolf | Qualcomm Incorporated |
| Dong, Xiandong | Xiaomi Inc. |
| ElSherif, Ahmed | Qualcomm Incorporated |
| Fang, Yonggang | ZTE TX Inc |
| Fischer, Matthew | Broadcom Corporation |
| Garg, Lalit | Broadcom Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Hamilton, Mark | Ruckus/CommScope |
| Han, Zhiqiang | ZTE Corporation |
| Hedayat, Ahmadreza | Charter Communications |
| Ho, Duncan | Qualcomm Incorporated |
| Hsu, Chien-Fang | MediaTek Inc. |
| Hu, Chunyu | Facebook |
| Huang, Guogang | Huawei |
| Huang, Po-Kai | Intel Corporation |
| Jang, Insun | LG ELECTRONICS |
| Jiang, Jinjing | Apple, Inc. |
| Jung, hyojin | Hyundai Motor Company |
| Kain, Carl | USDoT |
| Kim, Jeongki | LG ELECTRONICS |
| kim, namyeong | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lan, Zhou | Broadcom Corporation |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Lv, kaiying | MediaTek Inc. |
| Lv, Lily | Huawei Technologies Co. Ltd |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Naribole, Sharan | SAMSUNG |
| Ouchi, Masatomo | Canon |
| Park, Minyoung | Intel Corporation |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Raissinia, Alireza | Qualcomm Incorporated |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Tanaka, Yusuke | Sony Corporation |
| Torab Jahromi, Payam | Facebook |
| VIGER, Pascal | Canon Research Centre France |
| Wang, Hao | Self |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wang, Xiaofei | InterDigital, Inc. |
| Yang, Bo | Huawei Technologies Co. Ltd |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| Zhou, Yifan | Huawei Technologies Co., Ltd |
| Zuo, Xin | Tencent |

1. The Chair reminds that the agenda can be found in 11-20/425r30.
   * Technical Submissions-**ML Constrained Ops**:
     + Deferred SPs: [487r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-02-00be-multiple-link-operation-follow-up.pptx) (4 SPs), [226r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-04-00be-mlo-constraint-indication-and-operating-mode.pptx) (2 SPs), [433r5](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-05-00be-ppdu-alignment-in-str-constrained-multi-link.pptx) (1SP), [329r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-04-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx) (1 SP)
   * Technical Submissions: **ML-Block Ack**
     + [0012r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0012-00-00be-multi-link-acknowledgement-follow-up.pptx) Multi-link Acknowledgement Follow Up (Taewon Song)
     + [0024r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0024-00-00be-mlo-acknowledgement-procedure.pptx) MLO: Acknowledgement procedure (Abhishek Patil)
     + [0053r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0053-00-00be-multi-link-ba.pptx) Multi-link BA (Po-Kai Huang)
     + [0055r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0055-00-00be-multi-link-block-ack-architecture.pptx) Multi-link block ack architecture (Rojan Chitrakar)
     + [0122r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0122-00-00be-a-bar-variant-for-multi-link-operation.pptx) A BAR Variant For Multi-Link Operation (Chunyu Hu)
     + [432r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0432-00-00be-bug-fix-for-acknowledgement-rule-in-multi-link.pptx) Bug fix for Acknowledgement rule in multi-link (Yunbo Li)
     + [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho)
     + [448r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0448-00-00be-multi-link-ba-bitmap-parsing-rule.pptx) Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)
     + [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)
   * Technical Submissions: **ML-Operation**
     + 1930r3 AP-assisted ML operation (Dibakar Das) [1 SP]
     + 119r0 Follow Up Discussion on Multi-link Operation (Xiaofei Wang) [2 SPs]
     + 314r0 MLO: BSS Color (Abhishek Patil)
     + 358r0 Multi-BSSID Operation with MLO (Abhishek Patil)
     + 430r0 RTS/CTS for multi-link (Taewon Song)
     + 442r0 MLA: Group addressed frames delivery (Duncan Ho)
     + 488r0 Multi-link group addressed data delivery (Po-Kai Huang)
     + 489r0 Applied Case Study of Multi-link Framework and Operation (Yoshihisa Kondo)

**Submissions**

1. [**487r**](https://mentor.ieee.org/802.11/dcn/20/11-20-0487-02-00be-multiple-link-operation-follow-up.pptx)**3, Multiple Link Operation Follow Up, Liwen Chu (NXP) Only SP**

* **SP1 of r5: Do you support that in non-STR STA MLD, the simultaneous transmission in two links through backoff in one link (link 1) and enhanced PIFS idle/busy check in another link (link 2) is allowed:NAV checking in primary 20MHz channel of link2 besides PIFS checking in other secondary channels of link2,The further method to guarantee fairness is TBD.**

Discussion:

C: Did you remove the backoff count?

A: Some people say for further detail we can add later.

C: I don’t think this is right approach. you proposed the PIFS access. Many things are TBD. Let’s do the study and the analysis

A: we have some fairness methods. There is some other’s opinions. So, I remove it.

C: Full mechanism should be defined..

C: DL/UL? or the device is STR/non-STR? Unclear. TBD part is incomplete.

A: This is for non-STR.

Results (Yes/No/Abstain/No Answer) : 19/26/27/14

* **SP2: Do you support to define a mode that when doing simultaneous frame exchanges with STA MLD without STR capability, the inter-frame space between the ending time of the short responding PPDU and the starting time of the following soliciting PPDU may be more than SIFS and no more than TBD time?Note: it may be required to do ED sensing when the IFS is longer than SIFS according to EU regulation.**

Discussion:

Results(Yes/No/Abstain/No Answer) : 12/36/33/16

1. [226r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0226-00-00be-mlo-constraint-indication-and-operating-mode.pptx), MLO Constraint Indication and Operating Mode, Sharan Naribole (Samsung), Only SP

* SP 1of r5: **Do you support the addition of the following text to TGbe SFD?A non-AP MLD may update its ability to perform simultaneous transmission and reception on a pair of setup links after multi-link setup.This update for any pair of setup links can be announced by non-AP MLD on any enabled link. NOTE – Specific signaling for update indication is TBDNOTE - Limitations on dynamic updating is TBD**

Discussion:

C: In the first fullet? Do you want to change it to STR or non-STR?

C: Seems reasonable. Always STR or non-STR

C: more generic STR or non-STR support.

C: If a pair of links is set up or changed, at that time STR or non-STR will be decided.

C: we can use the capability for this operation

C: I like the SP. This is straightforward for dynamic update.

C: How about single radio? There are three type of device, single radio, STR, non-STR. STR is not for single radio case.

C: How about change it to STR/non-STR indication?

C: This is about non-AP MLD. What about AP MLD? We need to clarify the case of AP MLD as well.

Results(Yes/No/Abstain/No Answer) : 43/7/29/19

* **SP2: Do you support the addition of following text to the TGbe SFD?**
* **STR:** simultaneous transmit and receive
* **STR operation**, by an MLD in reference to a pair of links, is defined as the operation in which the MLD indicates the ability to support reception on one link while simultaneously transmitting on the other link.
  + NOTE - Specific requirements is TBD
* **Non-STR operation**, by an MLD in reference to a pair of links, is defined as the operation in which the MLD indicates constraints to support reception on one link while simultaneously transmitting on the other link.
  + NOTE - Specific constraints indicated is TBD

Discussion:

C: STR is for simultaneously TX&RX in the different links, not the same link. Clarify it in STR.

C: why do we define the operation instead of defining the capability of that operation?

C: Does this text support that one link support STR and different links support non-STR

C: we don’t need to mention the MLD or MLD indicates … we don’t need to mention the STR or non-STR capability for simplification.

A: I change from indicate to has.

C: you don’t need to mention a pair of links as well. You already mentioned RX in one link and TX in other link.

A: it makes this more clear.

C: For constraints in non-STR, which constraints is considered here?

C: For wording alignment, the MLD has ability .. and MLD has constraints …, make the alignment.

A: Ability,

C: for example, an MLD is capable of STR but I’ll do non-STR operation. ??

SP is deferred

1. [433r5](https://mentor.ieee.org/802.11/dcn/20/11-20-0433-05-00be-ppdu-alignment-in-str-constrained-multi-link.pptx), PPDU alignment in STR constrained multi-link, Yunbo Li (Huawei) only for SP

**Do you support below synchronization requirement?**

* **When a MLD1 transmit PPDU1 and PPDU2 in link 1 and link 2 respectively to a MLD2 which is STR constrained, if PPDU1 and PPDU2 has time domain overlapping, then the offset of ending time of PPDU2 compare with ending time of PPDU1 should follow below table**
  + **T1 = SIFS – non-negative TBD value;**
  + **0< T2 < T1, and the value of T2 is TBD.**



Disucssion:

C:Seems like that this is different from r5 in server.

A: He just downloaded it from the server. Please check yours.

C: for with ending time ..., is it just recommendation?

...

A: I prefer ” should ”

C: Do you mean the ending time is adopted to all PPDUs?

C: what if the MLD transmit the 3 ppdus?

C: You means this will be adopted to all PPDUs?

A: Yes

C: how does this adopt A-MPDU padding with symbol time e.g., 8us or 16us?

C: I think we need to have more time for T2, T1, specially for T2<T1.

A: T2 and T1 are still TBD, at next time we will discussion the specific value.

C: Do you want to run or modify?

A: I want to keep current text.

Y/N/Abs/no answer: 37/16/28/15

1. [329r5](https://mentor.ieee.org/802.11/dcn/20/11-20-0329-04-00be-group-addressed-frame-transmission-in-constrained-multi-link-operation.pptx), Group addressed frame transmission in constrained multi-link operation, Yongho Seok (MediaTek) only for SP

* **SP2 of 329r5, Do you support the following group addressed frames delivery mechanism?**

The non-STR non-AP MLD may configure one link with the AP MLD to receive non-GCR group addressed frames, then during the non-GCR group addressed delivery in the configured link, then the AP MLD and non-STR non-AP MLD may not schedule frames soliciting an immediate response to each other on other links that overlap with the non-GCR group address frames.

Discussion:

C: I have concern on the configured link part.

A: I’m not proposing if AP is duplicating the group addressed frame on all links or not. It follows the existing rules.

C: Link 1 is dedicated link if AP has group frame in link 2, group addressed frame ...

A: .. whether the AP transmits the duplicated frame on whole links or not is seperate discssuion.

A: we may have different understands for group addressed frame TX/

C: whether configuring one link for group addressed frame is TBD.

C: non-STR non-AP STR configured this one link for this . what about AP MLD?

A: I don’t want to mandate AP operation.

A: scheduling group addressed frame i don’t touch about that.

C: why not duplicate the frame in R1?

A: I agree with that.

C: If AP duplicates frames, we don’t need to configure link.

A: This is for unicast. You misunderstood. Only for non-GCR

C: Ok

C: clarify this. AP can reject the configuration?

C: I understand this operation. I just confirm what is the condition to signal the configured link is TBD? It means that AP reject the configuration?

C: Do you want to rush this? Or ...

A: At this moment, it cannot reject it.

C: But you didn’t answer like it during previous discussion with other people.

A: No

Yes/No/Abstain/No answer: 26/15/37/20

1. [0012r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0012-00-00be-multi-link-acknowledgement-follow-up.pptx) Multi-link Acknowledgement Follow Up (Taewon Song)

Summary: for non-STR operation, proposing the DL PPDU alignment and the ack policy restriction.

Discussion:

C: The ending time alignment is good proposal for solution. For ending time alignment, always padding is not efficient. Just AP will decide it.

A: the end time alignment is not mandatory.

C: On STA side, you’re tightly coupling?

A: Tight coupling may be needed.

C: For SP 1, I’m wondering this can be done by AP MLD. Do we need to really say something in spec?

A: You think this can be proceeded by AP MLD side.

C: If we don’t have it in the spec, AP MLD can decide whatever. Even if this I can still do it.

C: scheme 2 works only if STAs of MLD can exchange information very quickly. I think the scheme 1 is unique solution it’s work regardless of the MLD capability

C: When BAR is sent on link1, on the other link 2, DL or UL can be sent at that time on non-AP MLD.

A: in slide 6, compared to the left figure, the right figure is coner case. The length of BAR frame is not quite long compared to data frame. I wonder that we have to solve this situation.

C: SP 2, Do you want to add the time limit?

C: SP 2, there is also impact on the latency.

C: on the STR and non-STR discussion, Impact of this is very small in many of devices.

**The meeting was adjourned at 22:00**

**Friday, April 24, 2020, 10:00 – 13:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * If you are unable to record the attendance via [IMAT](https://imat.ieee.org/attendance) then please send an e-mail to Liwen Chu ([liwen.chu@nxp.com](mailto:liwen.chu@nxp.com)) and Jeongki Kim ([jeongki.kim@lge.com](mailto:jeongki.kim@lge.com))
   * The Webex app indicates about 99 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Abouelseoud, Mohamed | Sony Corporation |
| Adhikari, Shubhodeep | Broadcom Corporation |
| Au, Edward | Huawei |
| baron, stephane | Canon Research Centre France |
| Borgner, Jordan | Self |
| Bredewoud, Albert | Broadcom Corporation |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Choi, Jinsoo | LG ELECTRONICS |
| Chu, Liwen | NXP Semiconductors |
| Das, Dibakar | Intel Corporation |
| Das, Subir | Perspecta Labs Inc. |
| Doostnejad, Roya | Intel Corporation |
| Fang, Yonggang | ZTE TX Inc |
| Fischer, Matthew | Broadcom Corporation |
| Garg, Lalit | Broadcom Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Han, Zhiqiang | ZTE Corporation |
| Handte, Thomas | Sony Corporation |
| Hervieu, Lili | Cable Television Laboratories Inc. (CableLabs) |
| Hong, Hanseul | Yonsei University |
| Hu, Chunyu | Facebook |
| Hu, Mengshi | HUAWEI |
| Jang, Insun | LG ELECTRONICS |
| Jones, Vincent Knowles IV | Qualcomm Incorporated |
| Kain, Carl | USDoT |
| Kakani, Naveen | Qualcomm Incorporated |
| kim, namyeong | LG ELECTRONICS |
| Kim, Jeongki | LG ElECTRONICS |
| Kim, Sanghyun | WILUS Inc |
| Kim, Yongho | Korea National University of Transportation |
| Kim, Youhan | Qualcomm Incorporated |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Kneckt, Jarkko | Apple, Inc. |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Lansford, James | Qualcomm Incorporated |
| Levitsky, Ilya | IITP RAS |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Liang, dandan | Huawei Technologies Co., Ltd |
| LIU, CHENCHEN | Huawei Technologies Co., Ltd |
| Lv, kaiying | MediaTek Inc. |
| Monajemi, Pooya | Cisco Systems, Inc. |
| Ouchi, Masatomo | Canon |
| Park, Minyoung | Intel Corporation |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Petrick, Albert | InterDigital, Inc. |
| Raissinia, Alireza | Qualcomm Incorporated |
| Sedin, Jonas | Ericsson AB |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Strauch, Paul | Qualcomm Incorporated |
| Sun, Bo | ZTE Corporation |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Verma, Sindhu | Broadcom Corporation |
| VIGER, Pascal | Canon Research Centre France |
| Wang, Lei | Huawei R&D USA |
| Yang, Jay | Nokia |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yu, Jian | Huawei Technologies Co., Ltd |
| Yu, Mao | NXP Semiconductors |
| Zhou, Yifan | Huawei Technologies Co., Ltd |

1. The Chair reminds that the agenda can be found in 11-20/425r31.
   * Technical Submissions: **ML-Block Ack**
     + [012r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0012-00-00be-multi-link-acknowledgement-follow-up.pptx) Multi-link Acknowledgement Follow Up (Taewon Song) [Q&A]
     + [024r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0024-00-00be-mlo-acknowledgement-procedure.pptx) MLO: Acknowledgement procedure (Abhishek Patil)
     + [053r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0053-00-00be-multi-link-ba.pptx) Multi-link BA (Po-Kai Huang)
     + [055r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0055-00-00be-multi-link-block-ack-architecture.pptx) Multi-link block ack architecture (Rojan Chitrakar)
     + [122r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0122-00-00be-a-bar-variant-for-multi-link-operation.pptx) A BAR Variant For Multi-Link Operation (Chunyu Hu)
     + [397r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0397-01-00be-sequence-number-and-ba-operation-with-large-ba-buffer-size.pptx) Sequence number and BA operation with large BA buffer size (Liwen Chu)
     + [432r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0432-00-00be-bug-fix-for-acknowledgement-rule-in-multi-link.pptx) Bug fix for Acknowledgement rule in multi-link (Yunbo Li)
     + [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho)
     + [448r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0448-00-00be-multi-link-ba-bitmap-parsing-rule.pptx) Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)
     + [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)
   * Technical Submissions: **ML-Operation**
     + 1930r3 AP-assisted ML operation (Dibakar Das) [1 SP]
     + 119r0 Follow Up Discussion on Multi-link Operation (Xiaofei Wang) [2 SPs]
     + 314r0 MLO: BSS Color (Abhishek Patil)
     + 358r0 Multi-BSSID Operation with MLO (Abhishek Patil)
     + 430r0 RTS/CTS for multi-link (Taewon Song)
     + 442r0 MLA: Group addressed frames delivery (Duncan Ho)
     + 488r0 Multi-link group addressed data delivery (Po-Kai Huang)
     + 489r0 Applied Case Study of Multi-link Framework and Operation (Yoshihisa Kondo)

**Submissions**

1. [012r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0012-00-00be-multi-link-acknowledgement-follow-up.pptx) Multi-link Acknowledgement Follow Up (Taewon Song) [Q&A]

Discussion:

Chair: Remaining Q&A queue is Zhou. Do you have question, Zhou?

NO response.

C: Do you have SPs?

A: Yes, but I will defer my SPs to get a consensus.

1. 024r2 MLO: Acknowledgement procedure (Abhishek Patil)

Summary:

* **For ack status received for MPDUs transmitted on another link:**
  + A value 0 in the BA Bitmap provides no information
    - This is because the STA cannot determine if an MPDU is yet to be transmitted by another STA of the MLD or is in-transit on another link or is indeed lost or will be retried.
  + A value 1 in the BA Bitmap is unambiguous and indicates that the MPDU was successfully received

Discussion:

C: What is the local retry policy?

C: Liwen’s SP was passed at Jan meeting. I think SP 1 is similar to it. What is the difference between them?

A: Just clarify the text with the ”information on successful reception”.

C: Slide 7, in some case, 0 can have meaning.

A: MLD know how the aggreation ... receive status of value 1 is unambiguous 100%. But For 0 does know what happen? ...

C: For transmitter side, 0 can be interpreted clearly in some case.

C: slide 7, similar to yunbo, in case of 0. Without some alignment between BA or PPDUs, it can be some problem.

A: your proposal is more related to constraints device that PPDU or BA should be aligned. This is unique solution.

C: once it received 0, it retransmits. In case of 0, it will prepare the retransmission.

....

A: in slide 7, if MPDU7 is 1 and 8 & 9 are 0, the transmitter cannot trust the receive status.

C: The question is regarding the aggregated BA , if the aggregated BA is used, it can contain the full information instead of partial information.

C: This is not clear whether this is partial information or full information.

C: This covers all cases regardless of STR or non-STR.

C: slide 7, this is transmitter side. If 7 is 0 and 8 is 1, in this case MLD ignores 0 for 7. I think this is useful.

A: Sure, ...

C: SP 1 is recepient behavior. What does it mean successful reception? Is it 1?

C: I support this.

C: I agree that 1 is unambiguous and 0 is ambiguous. I want to mention the solution for 0 value. You just ignore. But in some case, 0 has meaning according to solutions. 0 value is useful.

A: Again, I just want to mention the local retry policy. 7 and 8 are 0 and 9 is 1. STA1 will retry 7 and 8 but STA D does not need to retry 7 and 8. That is STA D doesn’t care about 0 of 7 and 8.

A: 0 can be trusted and 1 is not ambiguous.

C: Can you defer the SP?

A: For SP 1, may provide information on successful reception. There is no text of failure case.

C: slide 7, Can i know the TXOP value of both parts?

....

**SP1 of 24r2: Do you support that the 802.11be amendment shall define mechanism for multi-link operation that enables the following:A STA of a recipient MLD shall provide receive status for MPDUs received on the link that it is operating on and may provide (if available) information on successful reception of MPDUs received by another STA of that MLD**

C: I have the presentation which is very closed to you.

A: Maybe is yours related to value 0?

C: No, mine is to clarify the liwen’s motion text.

A: Do you believe value 1 is unambiguous? Then, I think yours is not conflict with mine.

Yes/No/Abstain/No Answer: 48/5/23/8

SP2: Do you agree that an originator MLD of an BA agreement:shall update the receive status for an MPDU corresponding to the BA agreement only if the received status indicates successful reception.shall not update the receive status for an MPDU corresponding to the BA agreement that has been already positively acknowledged.

C: I disucssed with Abhi, just now. This one is quite complex. Can you run this after my presentation?

A: This is based on the baseline spec (10.25.6.8 Maintaining block ack state at the originator). I’m not proposing new. I just clarify it in terms of MLD level

C: I just have concern on the ”only” which is related to 0 value.

A: I’m fine but this text came from baseline.

C: Do we need to repeat this if this is same as baseline?

Chair: Do you want to modify or run?

C: can we run it without only?

C: Why we duplicate if it’s in the MLD?

A: the baseline is STA and this is MLD. Just difference

C: But the baseline only mentions the originator without STA.

C: Please delete the only or defer this after mine.

A:Ok, I’ll see yours. I’ll defer this SP

SP is defered

1. [053r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0053-00-00be-multi-link-ba.pptx) Multi-link BA (Po-Kai Huang)

Summary:

propose to have only one transmit buffer control for negotiated BA between two MLDs

512/1024 BA is needed for single radio or dual radio aggregation under EHT data rate considering common 2 spatial stream use case

* Propose signaling to expand table 26-1 and indication in compressed BA and Multi-STA BA for 512 and 1024.

Discussion:

C: 512/1024, analysis is very good. 1024 only cover SU case. For MU case, ....

512 is pratical . 512 is mandatory and 1024 is optional.

A: I agree with you. Negotiated buffer size is optional. I don’t touch what is mandatory or not. The capability of that can be negotiated.

C: one transmit buffer control, score board.

A: Transmit Buffer control is just a logical represenation. I believe we don’t generalize this and we don’t need to define this rule.

C: transmission window may be different. That’s implementation.

A: transmit buffer is not queue. Just logical representation.

C: MAC efficiency, if bitmap size increases then, efficiency decrease. Why?

C: slide 5, why do we have two level? We already have STA level in the spec.

A: You can have different queues for managment. ...

C: slide 4, why do we still have both leve? In SP1, you mention transmitter buffer control for MLD level. But you don’t mention for the STA level.

C: regarding bitmap expansion, 11ay already has 10k bitmap. I agree. Just minor thing, it seems 1023 instead of 1024.

A: Ok. Changed

C: for MAC efficiency, slide 9, ...

C: SP4, mutli-STA BA...

A: I agree with you

SP1: Do you support that for each block ack agreement between two MLDs, there exists one transmit buffer control to submit MPDUs for transmission across links?- TBD for separate transmit buffer control

48/1/41/7

SP2:

* **Do you support to extend the negotiated Block Ack buffer size to be smaller than or equal to 1024 and define 512-bits and 1024-bits BA bitmap in R1?**

A:I change from 1024 to 1023 only.

C: We can use extended element in the addBA

A: I just keep the original text

45/0/43/9

* SP 3: **Do you support to extend table 26-1 as shown below?**

|  |  |  |
| --- | --- | --- |
| **Negotiated buffer size** | **Bitmap in compressed BA** | **Bitmap in multi-STA BA** |
| 1-64 | 64 | 32 or 64 |
| 65-128 | 64 or 256 | 32, 64, 128 |
| 129-256 | 64 or 256 | 32, 64, 128, or 256 |
| 257 – 512 | 64 or 256 or 512 | 32, 64, 128, 256, 512 |
| 513 - 1024 | 64 or 256 or 512 or 1024 | 32, 64, 128, 256, 512, or 1024 |

C: ...

A: extension table ?

C: is there any objection on table?

C: for Multi-STA how to make 512 – 1024 bitmap? Unicast or multi-cast?

A: you can use individual address. Group address may be possible.

C: Good to say together with Duncun.

C: How about just run compressed BA?

A: I’m fine with defer this after duncun.

SP is defered

1. [055r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0055-00-00be-multi-link-block-ack-architecture.pptx) Multi-link block ack architecture (Rojan Chitrakar)

Summary:

proposed that the block ack agreement for a TID that may be transmitted over multiple links be allowed to maintain different scoreboard sizes for different links.

proposed that a recipient MLD may maintain a common scoreboard to consolidate the receipt status of MPDUs of a TID received via different links.

Discussion:

C: partial state on each link is enough?

A: partial or full is implementation. I’m not proposing that.

C: If I have a single radio, I can switch. If I have two radio, ..... the spec allow the partial states ... 11ax allows the bitmap size

A: This is the maximum value negotiated.

C: This is the implementation specific.

C: I agree with your proposal. Different bandwidth and different antena have different scoreboard size.

C: slide 3, is the common transmitter buffer the logic sense? It’s implementation choice.

A: I agree with you. MLD want to decide that. This could be logical definitly.

C: scoreboard size,

A: size is different ?

C: the range is quite not sure. There are two cases. Link 1 is .......

A: One of STAs one STA has a limitation, The sequence number space makes two. Each link has 1024, in one txop. It may happen.

C: to see the problem, I want to limit the BA window.

C: First of all, in the architecture wise, I agree. Slide 4, this is fine with common seuquence number and so on. For scoreboard size, i don’t see the motivation for different size of different links. ...

A: I agree with you that data rate may be different on different links.

C: how do we grow ...

C: slide 6, you’re proposing the common scoreboard on top of the per-link scoreboard. What is the problem on only having common scoreboard?

C: That is no thing

Time out during the discussion.

**The meeting was adjourned at 13:00 ET**

**Monday, April 27, 2020, 19:00 – 22:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * If you are unable to record the attendance via [IMAT](https://imat.ieee.org/attendance) then please send an e-mail to Liwen Chu ([liwen.chu@nxp.com](mailto:liwen.chu@nxp.com)) and Jeongki Kim ([jeongki.kim@lge.com](mailto:jeongki.kim@lge.com))
   * The Webex app indicates about 99 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Name | Affiliation |
| Abouelseoud, Mohamed | Sony Corporation |
| Aboulmagd, Osama | Huawei Technologies Co.,  Ltd |
| Adachi, Tomoko | TOSHIBA Corporation |
| Akhmetov, Dmitry | Intel Corporation |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Au, Kwok Shum | Huawei Technologies Co., Ltd |
| Bims, Harry | Bims Laboratories, Inc. |
| Carney, William | Sony Corporation |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Das, Dibakar | Intel Corporation |
| Ding, Baokun | Huawei Technologies Co. Ltd |
| Fang, Yonggang | ZTE TX Inc |
| Garg, Lalit | Broadcom Corporation |
| Ghosh, Chittabrata | Intel Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Hamilton, Mark | Ruckus/CommScope |
| Han, Zhiqiang | ZTE Corporation |
| Ho, Duncan | Qualcomm Incorporated |
| Hong, Hanseul | Yonsei University |
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| Jang, Insun | LG ELECTRONICS |
| Jiang, Jinjing | Apple, Inc. |
| Jung, hyojin | Hyundai Motor Company |
| Kain, Carl | USDoT |
| kim, namyeong | LG ELECTRONICS |
| Kim, Jeongki | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Yongho | Korea National University of Transportation |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Lan, Zhou | Broadcom Corporation |
| Levy, Joseph | InterDigital, Inc. |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Liu, Yong | Apple, Inc. |
| Lv, kaiying | MediaTek Inc. |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Nezou, Patrice | Canon Research Centre France |
| Ouchi, Masatomo | Canon |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Raissinia, Alireza | Qualcomm Incorporated |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Torab Jahromi, Payam | Facebook |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wang, Xiaofei | InterDigital, Inc. |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| yi, yongjiang | Futurewei Technologies |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| Zhou, Yifan | Huawei Technologies Co., Ltd |
| Zuo, Xin | Tencent |

1. The Chair reminds that the agenda can be found in 11-20/425r32.
   * Technical Submissions: **ML-Block Ack**
     + [122r10](https://mentor.ieee.org/802.11/dcn/20/11-20-0122-00-00be-a-bar-variant-for-multi-link-operation.pptx) A BAR Variant For Multi-Link Operation (Chunyu Hu)
     + [397r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0397-01-00be-sequence-number-and-ba-operation-with-large-ba-buffer-size.pptx) Sequence number and BA operation with large BA buffer size (Liwen Chu)
     + [432r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0432-00-00be-bug-fix-for-acknowledgement-rule-in-multi-link.pptx) Bug fix for Acknowledgement rule in multi-link (Yunbo Li)
     + [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho)
     + [448r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0448-00-00be-multi-link-ba-bitmap-parsing-rule.pptx) Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)
     + [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)
   * Technical Submissions: **ML-Operation**
     + 1930r3 AP-assisted ML operation (Dibakar Das) [1 SP]
     + 119r0 Follow Up Discussion on Multi-link Operation (Xiaofei Wang) [2 SPs]
     + 314r0 MLO: BSS Color (Abhishek Patil)
     + 358r0 Multi-BSSID Operation with MLO (Abhishek Patil)
     + 430r0 RTS/CTS for multi-link (Taewon Song)
     + 442r0 MLA: Group addressed frames delivery (Duncan Ho)
     + 488r0 Multi-link group addressed data delivery (Po-Kai Huang)
     + 489r0 Applied Case Study of Multi-link Framework and Operation (Yoshihisa Kondo)
   * Discussion:
     + C: Do you have SPs of 55r2?
     + A: Yes, 2 SPs

**Submissions**

1. [055r2](https://mentor.ieee.org/802.11/dcn/20/11-20-0055-00-00be-multi-link-block-ack-architecture.pptx) Multi-link block ack architecture (Rojan Chitrakar) Only for SPs

**SP1: Do you support to add the following to the 11be SFD:**

* + **Different scoreboard sizes may be negotiated for different links of an MLD during negotiation of a block ack agreement for a TID that may be transmitted over one or more links.**

Discussion:

C: Signaling is link level or MLD level?

A: Signaling is based on MLD side

C: You assumption is BA agreement is link basis or MLD level?

A: Agreement is MLD which is already in SFD.

C: Similar to previous one. I think we don’t need this.

C: Scoreboard size is same or different?

Yes/No/Abstain/No Answer: 14/22/34/17

SP2: **Do you support to add the following to the 11be SFD:**

* + **An MLD may maintain a common scoreboard to record the receipt status of MPDUs of a TID received via different links?**

Discussion:

Discussion:

C: if you say this, does it mean any rule?

C: This is related to implementation specific.

C: It’s already allowed. What do you want to do here?

A: What is allowed?

C: MLD already manages the TID and so on.

A: So far, STA has a single reorder buffer.

C: what is expected?

C: what does it mean ”may ...”? that means the MLD does not maintain...?

A: Passed SP mentions scoreboard is link basis.

C: all link STA maintains each socreboard and MLD additionally maintains common scoreboard ?

A: Yes

C: It’s implemenation issue.

C: This is not implementation. Already Scoreboard management text is in the spec.

Yes/No/Abstain/No answer: 16/15/43/21

1. [122r](https://mentor.ieee.org/802.11/dcn/20/11-20-0122-00-00be-a-bar-variant-for-multi-link-operation.pptx)1 A BAR Variant For Multi-Link Operation (Chunyu Hu)

Summary:

* **Define a new BAR variant (L-BAR) that notifies the A-MPDU responder that it skipped transmitting a sequence number range or numbers set in a bitmap; and it avoids moving the BA window start SN**

Discussion:

C: I wonder if this enhanced BAR solicits BA or just delivering the information?

C: slide 3, In spec, we don’t have local receive buffer or global buffer. Clarify the SP text.

C: slide 3, There is local buffer and global buffer. I think we don’t need local buffer.

C: slide 4, what is the function of SN in new BAR?

A: it can reduce the local processing delay. i.e.,

C: what purpose is this information?

A: for reducing the internal processing delay, additional information is delivered.

C: is local rx buffer same as reordering buffer?

C: You means local rx buffer has the same function as reordering buffer. I don’t think this is needed. Local buffer just send to upper (MLD)

C: I think the architecture is not clear to me.

C: if we manage global buffer then we don’t need local one.

C: some observations... firstly There is nothing to preventing forwaring from local to global. ... secondly, regarding L-BAR...

C: slow link can block the fast link

C: I don’t know why local buffer forward to MLD immediately.

C: SP2 also allows MU-BAR?

SP is defered

1. [397r](https://mentor.ieee.org/802.11/dcn/20/11-20-0397-01-00be-sequence-number-and-ba-operation-with-large-ba-buffer-size.pptx)2 Sequence number and BA operation with large BA buffer size (Liwen Chu)

Summary:

the Fragment Number field in Block Ack Starting Sequence Number Control indicates the additional BA Bitmap length of 512, 1024

in a Multi-STA Block Ack frame, multiple consecutive Per AID TID Info fields with the same TID can be addressed to the same recipient (same AID). In this case, their bitmaps are concatenated to form a contiguous bitmap of 512 or 1024 for the recipient

an EHT STA can carry BA frame in wider BW PPDU other than non-HT PPDU to decrease the BA transmission overhead

Discussion:

C: SP 1, Po-kai has a similar thing. both options are mandatory or some option can have the compability?

A: During BA agreement, STA can announce its capability of them.

...

A: ... It’s not related to direct PPDU format. Other consideration, we may have TB PPDU , in some channel we have EHT TB PPDU.

C: We need to monitor PHY side for this.

A: M-BA is pretty long.

C: SP1, fully support this. we don’t need this figure. Just mention ...

C: SP3, 11ax already allow you to send BA with HE SU PPDU. In some sense, this is already allowed.

C: For SP 1 and SP2, you have different ways using M-BA.

A: The first is only for unicast M-BA. Other options can be used only for broadcast.

C: wider BW control response. It can be sent with any PPDUs.

C: For BA, same as Po-kai, For TXOP truncation, this is allowed in baseline spec. What is the difference?

A: Same as base line

C: What does it mean the first bullet? SSN may be ignored ...

C: SP 2, we have SP regarding this. which option do you prefer?

C: Do we need to increase the sequence number size in MPDU?

A: In option 1, we don’t need to increase SN size.

SP is defered

1. [432r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0432-00-00be-bug-fix-for-acknowledgement-rule-in-multi-link.pptx) Bug fix for Acknowledgement rule in multi-link (Yunbo Li)

Summary:

* + Clarification of the existing SFD text for multi-link BA

Discussion:

C: Do you want to suggest that the orignator allows No Ack Policy for QoS Data on one link and implicit BA/BA for the same QoS data on the other link?

C: example1, partial state information, ... receiver may loss that..

C: we don’t need to mention all coditions

C: if the ack policy is no ack ,....

C: In example 2, is it allowed to have the different ack policy for the same QoS data?

C: why don’t you send BAR on two links instead of waiting to receive BAR on only one link?

A: That’s implementation issue. For example, if TXOPs for two links are different, BAR may not be sent during the specified TXOP on one link.

SP is defered

1. [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho)

Summary:

Discussion:

C: SP3, Option 1 can support the backward compatibility.

C: What is the issue of backward compability on option 1?

C: slide 4, when the Fragmenation is ON, 2 reserved combination

C: I think two options can be co-existed

C: we can option 2 for individually addressed and option 1 for broadcast addressed if there is backward compability issue

A: I prefer the single option based on the majority

C: slide 4, why do we need explicit indication to .. I think bitmap length is STA issues. Not AP.

**The meeting was adjourned at 22:00 ET**

**Monday, May 4, 2020, 10:00 – 13:00 ET (TGbe MAC ad hoc conference call)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

This meeting took place using a webex session.

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:05 EDT. The Chair introduces himself and the Secretary, Jeongki Kim (LG)
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 recommends to use IMAT for recording the attendance.
   * Please record your attendance during the conference call by using the IMAT system:
     1. 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802.11 Telecons (<Month>)” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbe <MAC/PHY/Joint> conference call that you are attending.
   * If you are unable to record the attendance via [IMAT](https://imat.ieee.org/attendance) then please send an e-mail to Liwen Chu ([liwen.chu@nxp.com](mailto:liwen.chu@nxp.com)) and Jeongki Kim ([jeongki.kim@lge.com](mailto:jeongki.kim@lge.com))
   * The Webex app indicates about 83 people on the call.  
       
     **Recorded attendance through Imat and e-mail:**

|  |  |
| --- | --- |
| Adhikari, Shubhodeep | Broadcom Corporation |
| Akhmetov, Dmitry | Intel Corporation |
| Asterjadhi, Alfred | Qualcomm Incorporated |
| Au, Kwok Shum | Huawei Technologies Co., Ltd |
| baron, stephane | Canon Research Centre France |
| Bredewoud, Albert | Broadcom Corporation |
| Cheng, Paul | MediaTek Inc. |
| CHERIAN, GEORGE | Qualcomm Incorporated |
| Chitrakar, Rojan | Panasonic Asia Pacific Pte Ltd. |
| Das, Subir | Perspecta Labs Inc. |
| Derham, Thomas | Broadcom Corporation |
| Fang, Yonggang | ZTE TX Inc |
| Garg, Lalit | Broadcom Corporation |
| Ghosh, Chittabrata | Intel Corporation |
| Guo, Yuchen | Huawei Technologies Co., Ltd |
| Gwak, Yongsu | Korea National University of Transportation |
| Han, Jonghun | SAMSUNG |
| Handte, Thomas | Sony Corporation |
| Ho, Duncan | Qualcomm Incorporated |
| Hu, Chunyu | Facebook |
| Huang, Po-Kai | Intel Corporation |
| Hwang, Sung Hyun | Electronics and Telecommunications Research Institute (ETRI) |
| Jiang, Jinjing | Apple, Inc. |
| Kain, Carl | USDoT |
| Kakani, Naveen | Qualcomm Incorporated |
| Kandala, Srinivas | SAMSUNG |
| kim, namyeong | LG ELECTRONICS |
| Kim, Jeongki | LG ELECTRONICS |
| Kim, Sang Gook | LG ELECTRONICS |
| Kim, Yongho | Korea National University of Transportation |
| Kishida, Akira | Nippon Telegraph and Telephone Corporation (NTT) |
| Ko, Geonjung | WILUS Inc. |
| Kondo, Yoshihisa | Advanced Telecommunications Research Institute International (ATR) |
| Kwon, Young Hoon | NXP Semiconductors |
| Lalam, Massinissa | SAGEMCOM BROADBAND SAS |
| Levitsky, Ilya | IITP RAS |
| Levy, Joseph | InterDigital, Inc. |
| Li, Yiqing | Huawei Technologies Co. Ltd |
| Li, Yunbo | Huawei Technologies Co., Ltd |
| Lu, Liuming | ZTE Corporation |
| Lv, kaiying | MediaTek Inc. |
| Lv, Lily | Huawei Technologies Co. Ltd |
| Max, Sebastian | Ericsson AB |
| Monajemi, Pooya | Cisco Systems, Inc. |
| NANDAGOPALAN, SAI SHANKAR | Cypress Semiconductor Corporation |
| Nezou, Patrice | Canon Research Centre France |
| Park, Minyoung | Intel Corporation |
| Park, Sung-jin | LG ELECTRONICS |
| Patil, Abhishek | Qualcomm Incorporated |
| Patwardhan, Gaurav | Hewlett Packard Enterprise |
| Raissinia, Alireza | Qualcomm Incorporated |
| RISON, Mark | Samsung Cambridge Solution Centre |
| Rosdahl, Jon | Qualcomm Technologies, Inc. |
| Sedin, Jonas | Ericsson AB |
| Seok, Yongho | MediaTek Inc. |
| Song, Taewon | LG ELECTRONICS |
| Sun, Li-Hsiang | InterDigital, Inc. |
| Sun, Yanjun | Qualcomm Incorporated |
| Torab Jahromi, Payam | Facebook |
| Verma, Sindhu | Broadcom Corporation |
| VIGER, Pascal | Canon Research Centre France |
| Wang, Hao | Tencent |
| Wang, Huizhao | Quantenna Communications, Inc. |
| Wang, Lei | Huawei R&D USA |
| Wentink, Menzo | Qualcomm |
| Yang, Jay | Nokia |
| Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| Yee, James | MediaTek Inc. |
| Yukawa, Mitsuyoshi | Canon, Inc. |
| Zhou, Yifan | Huawei Technologies Co., Ltd |

1. The Chair reminds that the agenda can be found in 11-20/425r35.
2. Technical Submissions: **ML Block Ack**
   * [441r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho) [Q&A, SP]
   * [448r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0448-00-00be-multi-link-ba-bitmap-parsing-rule.pptx) Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)
   * [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)
3. Technical Submissions: **ML-Operation**
   * [136r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0136-01-00be-virtual-carrier-sense-in-multi-link.pptx) Virtual Carrier Sense in Multi-Link (Thomas Handte) [1 SP]
   * [1930r3](https://mentor.ieee.org/802.11/dcn/19/11-19-1930-03-00be-ap-assisted-multi-link-operation.pptx) AP-assisted ML operation (Dibakar Das) [1 SP]
   * [119r1](https://mentor.ieee.org/802.11/dcn/20/11-20-0119-01-00be-follow-up-discussion-on-multi-link-operations.pptx) Follow Up Discussion on Multi-link Operation (Xiaofei Wang) [2 SPs]
   * [314r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0314-00-00be-mlo-bss-color.pptx) MLO: BSS Color (Abhishek Patil)
   * [358r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0358-00-00be-multi-bssid-operation-with-mlo.pptx) Multi-BSSID Operation with MLO (Abhishek Patil)
   * [430r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0430-00-00be-rts-cts-for-multi-link.pptx) RTS/CTS for multi-link (Taewon Song)
   * [442r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0442-00-00be-mla-group-addressed-frames-delivery.pptx) MLA: Group addressed frames delivery (Duncan Ho)
   * [488r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0488-00-00be-multi-link-group-addressed-data-delivery.pptx) Multi-link group addressed data delivery (Po-Kai Huang)
   * 489r0 Applied Case Study of Multi-link Framework and Operation (Yoshihisa Kondo)

Discussion:

C: After Block Ack, some defered SPs. 122r4, 397, 53, 24,

C: One more is 432r1

Agenda is changed.

The modified agenda is approved.

**Submissions**

1. [441r3](https://mentor.ieee.org/802.11/dcn/20/11-20-0441-00-00be-mla-ba-format.pptx) MLA: BA Format (Duncan Ho) [Q&A, SP]

Summary: Explaining the conclusion and SPs.

Discussion:

C: Good summary. For conclusion, I think for the first and second I support them. For M-BA, I prefer option 2. Same as your conclusion.

C: for SP3, I’m fine.

Chair: Which one is first?

A: SP3

* SP3 of 441r3: **Do you agree to add to the TGbe SFD:**
  + For a M-BlockAck frame, add support for 512/1024 bitmap lengths by:
    - Including new BA Bitmap lengths (of 512 and 1024 bits), where the length of the BA Bitmap field is signaled in the Per AID TID Info field addressed to an EHT STA
    - The M-BA frame containing these Per AID TID Info fields is not sent as a response to an HE TB PPDU generated by at least one HE STA.
  + Yes/No/Abstain/No answer: 36/1/35/6
* **SP2 of 441r3: Do you agree to add to the TGbe SFD:**
  + For a Compressed BlockAck frame, use some of the reserved values of the Fragment Number field of the BlockAck frame to indicate the added bitmap lengths (512 and 1024).

Yes/No/Abstain/No answer:46/0/29/5

1. [448r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0448-00-00be-multi-link-ba-bitmap-parsing-rule.pptx) Multi-Link-BA-Bitmap-Parsing-Rule (Jason Yuchen Guo)

Summary:

**propose a multi-link BA bitmap parsing rule, under which the data transmitter can determine each bit in the BA bitmap as trustable or not**

**propose 3 different ways of parsing the BA bitmap, which correspond to 3 different levels of capabilities**

**STAs can announce the capability of transmitting multi-link BA during the BA setup procedure**

Disucssion:

C: slide 9, I was say, Level 0 is the simplest. We generally do that. For level 2, are you sure this differentiation? ...

A: .. still STAs can announce the capbility of this.

C: Level 1, you consider partial states. ...

A: I assume the full state in my proposal. But I’ll consider them.

C: Partial state is hard to ...

C: Agree with Po-kai. I believe level 0 is .. simple. Level 1 and 2 are complex while the unnecssary use case and limited benefit. I wonder how retry counter and policy work in them?

A: what is unnecessary case?

C: slide 3, B1 and B2 are 0, then link 2 and link 1 are retry

A: You mean link 2 is local retry and link 1 is MLD retry? If link 2 is local retry, why not local retry on link 1?

C: Yes, it could happen

C: Similar to previous people. Where is benefit in terms of throughput? Or Analysis.

A: Benefit is improving the delay.

C: Analysis needed

C: slide 5, there is unceratinty here. Even if we define MLIFS, then ....

A: receiver should announce the capability of it.

Chair: Do you want to SP?

A: I need further evaluation. Come back later with SPs.

1. [460r0](https://mentor.ieee.org/802.11/dcn/20/11-20-0460-00-00be-multi-link-ba-clarification.pptx) Multi-link BA Clarification (Yongho Seok)

Summary: Clarification of ML BA.

**Especially, for single TID-to-single link mapping case and all TIDs-to-single link mapping case**

Discussion:

C: slide 8, last bullet, BA agreement is MLD level, but here one link has an outsanding ..., can you elaborate?

A: Yes , right. MLD has ...

C: BA agreement is also MLD level. ... If we apply to sets of all link, we don’t have issue any more. Right?

C: Mapping change can be dynamic or semi-static?

...

A: I don’t why you mention reordering buffer. If MLD has an outstanding frame ... then we don’t have reordering issue.

C: what about TID to link mapping? Are you assuming no TID to link mapping on the link?

A: here ...

C: SP 2, It’s just about BA agreement. What about TID link mapping?

A: In slide 2, I mentioned TID to link mapping.

C: SP 1, we have motion regarding that? What is new?

A: this applied on all setup links. Original is one or more links.

C: is there anything here?

A: it’s more restricted with all setup links.

C: SP2, ... without BA agreement, TID could be sent on any links.

C: here MLD level is sequnece number and reordering buffer?or others?

A: Yes.

I can defer SPs.

1. 20/0122r4, A BAR Variant For Multi-Link Operation, Chunyu Hu (FB) , Only SP

* SP1: **Do you agree to define a new type of BAR used in the multi-link operation that can be used to notify the A-MPDU responder that it has skipped a range of sequence numbers and/or a subset of sequence numbers, and that the responder shall not move its BA window as result?**

Disucssion:

C: My question is ” **it has skipped a range of sequence numbers and/or a subset of sequence numbers,” what do you mean?**

C: the second is the responder shall not move ... is not clear to me.

A: different view. In some cases, you don’t need to indicate it at all.

C: it seems like more have clear ..

C: Is this really needed?

C: This is not for the protected BA . we still want to keep it.

A: I will add it as note.

C: for shall not move... we don’t need to indicate it in new BAR type.

C: This is target to specific implementation.

SP text is modified with note

**SP1: Do you agree to define a new type of BAR used in the multi-link operation that can be used to notify the A-MPDU responder that it has skipped a range of sequence numbers and/or a subset of sequence numbers, and that the responder shall not move its BA window as result?Note: this doesn’t apply to the protected BA case**

Yes/No/Abstain/No answer: 5/44/26/13

1. 397r4, Sequence number and BA operation with large BA buffer size, Liwen Chu (NXP) only SP

**SP1: Do you support to use B3 equal to 1, B2 B1 equal to 0 and B0 equal to 0 in Fragment Number field to indicate 512 BA bitmap length and to use B3 equal to 1, B2 B1 equal to 0 and B0 equal to 1 in Fragment Number field to indicate 1024 BA bitmap length in compressed BA and multi-STA BA?**

Discussion:

C: I have similar one. Fully support this.

C: Fragment number begins B0 in the spec. But it begins B3 in yours. Is it correct?

A: If you look at 11ax spec, B3 equal to 0 is used for other purpose.

SP is approved with unanimous consent

1. 53r4, Multi-link BA, Po-Kai Huang (Intel) Only SP

**SP3: Do you support to extend table 26-1 as shown below?**



No discussion and no objection.

SP is approved with unanimous consent

1. 24r2, MLO: Acknowledgement procedure, Abhishek Patil (Qualcomm) only SP

* SP2: **Do you agree that an originator MLD of an BA agreement:**
  + shall update the receive status for an MPDU corresponding to the BA agreement ~~only~~ if the received status indicates successful reception.
  + shall not update the receive status for an MPDU corresponding to the BA agreement that has been already positively acknowledged.

Discussion

C: first I have concern on the first bullet. Here, you mention that ...

Are you ok with removing only?

A: I think your level 1 and 2 has complex ...

C: If you keep this, we closed the chance to improve some case.

A: I’m ok with deleting only.

C: Can you seperate this two bullets ? I have concern on the first bullet.

A: we already applied to Jason’s comment

C: I want to change shall to may

A: What does it mean ”may”? It doesn’t have any meaning.

C: What is similar to baseline?

Yes/No/Abstain/No answer: 34/0/33/13

1. 432r1, Bug fix for Acknowledgement rule in multi-link, Yunbo Li (Huawei)

* **SP1: Do you agree to modify acknowledgement rule in multi-link as below:**
  + The receive status of a MSDU or A-MSDU in a QoS Data frames of a TID received on a link shall be signaled on the same link unless at least one of following conditions is true:
    - The receive status of the MSDU or A-MSDU has already be signaled in other available link(s) with corresponding bit in the BA be set to 1;
    - The corresponding Ack Policy of the MSDU or A-MSDU is set to No Ack.

Discussion:

C: This seems like receiver side status. how does the receiver know whether the BA is received or not on other link?

A: we don’t need to change the reciever side.

C: I have concern on MLD level retransmission. Link level has advantage.

C: I think this mean if AP MLD get the information, the AP MLD does not send BAR.

Yes/No/Abstains/No answer: 15/21/27/18

* SP 2: **Do you agree to modify acknowledgement rule in multi-link as below:**
  + The receive status of a MSDU or A-MSDU in a QoS Data frames of a TID received on a link may be signaled on other available link(s) if the Ack Policy is not set to No Ack.

Discussion:

C: Shall statement is same link, this is optional?

C: This should be shall

C: what is the difference between this and ahbi’s?

C: what is the follow action?

C: current SFD why do you need ”if”? SFD mentioned it’s optional.

C: Ack policy is not set to normal ack as well as No ack.

A: For normal ack, it’s implementation issue. It’s possible.

C: It’s different issue. If normal ack, it should not be sent on the other link.

A: I’ll defer this.

SP is defered

1. 460r2, Multi-link BA Clarification, Yongho Seok (MediaTek)

* SP1 of 460r3: **Do you support that, after the BA agreement of a TID between two MLDs, the common reordering buffer of the TID are applied on all setup links?**
* Discussion:

There was discussion on sequence number.

Sequence number part was deleted in the SP text

* SP passed with no objection.

Will go through remaining SP at next call.

**The meeting was adjourned at 13:00 ET**