IEEE P802.11
Wireless LANs

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| Minutes for 802.11 be MAC Ad-Hoc teleconferences in December 2019 and January 2020 |
| Date: 2020-01-09 |
| Author(s): |
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Abstract

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

Revisions:

* Rev0: Added the telephone conference held the 12th of December 2019.
* Rev1: Slightly updated
* Rev2: Added the telephone conference held the 19th of December 2019.
* Rev3: Added the telephone conference held the 09th of December 2020

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

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 10:03. The Chair introduces himself and the Secretary, Jeongki Kim (LG Electronics)
2. The Chair goes through the 802 and 802.11 IPR policy and procedures and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reminds everyone to report their attendance by sending an e-mail to the Secretary and the Chairman himself. Based on the join.me app, it appears to be around 70 people in the call.

**Recorded attendance through the join.me app and/or reported attendance through e-mail:**
	* Akira Kishida (NTT)
	* AL Petrick
	* Albert Bredewoud
	* Alfred Asterjadhi (Qualcomm)
	* Abhishek Patil (Qualcomm)
	* BARON Stephane (Cannon)
	* Dibakar das
	* Dmitry Akhmetov
	* Gaurav Patwardhan
	* George Calcev
	* Hanseul Hong (Yonsei Univ.)
	* Insun Jang (LG)
	* Jane Erickson
	* Jason Yuchen Guo
	* Jeongki Kim (LG)
	* Jonathan Segev
	* Kazuto Yano (ATR)
	* Liwen Chu (NXP)
	* Matt Brooks
	* Ming GAN
	* Minyoung Park
	* Myeongjin Kim
	* Pascal Viger
	* Rojan Chitrakar
	* Sang Kim (LGE)
	* Sebastian Max (Ericsson)
	* Sharan Naribole
	* Stephane Baron (Canon)
	* Suhwook Kim
	* Sungjin Park (LGE)
	* Taewon Song
	* Younghoon Kwon,
	* Yongho Seok

1. The Chair reminds that the agenda can be found in 11-19/2146r1. Today we will go through submissions related to multi-link.

**Submissions**

1. **11-19/1528r2, Multi-Link Operation - Link Management (Abhishek Patil)**

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

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

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

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

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

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

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

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

C: For association, need link enablement/disablement?

A: Before association, any link could be used.

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

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

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

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

1. **11-19/**[**1541r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1541-01-00be-performance-aspects-of-multi-link-operations-with-constraints.pptx)**-Performance aspects of multi link op with constraints (Dmitry Akhmetov)**

**Summary:** Multi-link device may need to impose constraints on concurrent TX/RX operations on different bands

Introducing 2 new modes of operation with restrictions

isolated (R)estricted MPC

Non-isolated (R)estricted MPC

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

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

**Discussion:**

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

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

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

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

**A:**

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

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

**Per-link power save operation**

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

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

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

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

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

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

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

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

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

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

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

**Summary:** **Performance evaluation per each MLO types**

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

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

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

**Discussion:**

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

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

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

1. **11-19/** [**1548r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1548-00-00be-channel-access-design-for-synchronized-multi-links.pptx)**-Channel access design for synchronized multi-links (Yunbo Li)
Summary:**.
**Channel Access Design for Synchronized Multi-Links** (using single primary channel for synchronized ML, Intra-BSS Solution 1, 2, Inter-BSS Solution)

**Discussion:**

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

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

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

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

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

**A:** I agree

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

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

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

A: AP side is also synchronous ML.

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

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

A: STA need to keep NAV for both links.

**Adjourned at 12:57 ET.**

**Thursday 19 December 2019, 19:00 – 22:00 ET (TGbe MAC ad hoc)**

Chairman: Liwen Chu (NXP)

Secretary: Jeongki Kim (LG Electronics)

**Introduction**

1. The Chair (Liwen Chu, NXP) calls the meeting to order at 19:16 due to some problem during call.. The Chair introduces himself and the Secretary, Jeongki Kim (LG Electronics)
2. The Chair goes through the 802 and 802.11 IPR policy and procedures and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reminds everyone to report their attendance by sending an e-mail to the Secretary and the Chairman himself. Based on the join.me app, it appears to be around 60 people in the call.

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	* Chunyu
	* Dibakar das
	* Duncan Ho
	* Edward Au
	* Greg Ko
	* Guogang Huang
	* Hanseul Hong (Yonsei Univ.)
	* Harry
	* Hirohiko INOHIZA
	* Insun Jang (LG)
	* James Yee
	* Jarkko Kneckt
	* Jeongki Kim (LG)
	* John Son
	* Joseph Levy
	* Kaiying Lu
	* Liwen Chu (NXP)
	* Manish Kumar
	* Ming Gan
	* Mohamed
	* Pooya
	* Ryuichi Hirata
	* Srinivas Kandala
	* Suhwook
	* Sungjin Par
	* Taewon Song
	* Tomo adachi
	* Tony Xiao Han
	* Xia, Qing
	* Xin zuo
	* Yongho Seok
	* Yongsu Gwak
	* Young Hoon Kwon
	* YUKAWA
	* Yunsong Yang
	* **Change from Join.me app to Skype app after first presentation and the related Q&A.**

**Submissions**

1. **1532r1-Discussion on Multi-link Acknowledgement (Ryuichi Hirata)**

**Summary:** **details of one of the QoS issues related to ARQ (Issue 2: unnecessary retransmission in [1]) and propose multi-link acknowledgement mechanism for synchronous and independent multi-link aggregation**

**5-15% block ack frames failed in TGax simulation scenarios (Residential, Enterprise and Indoor Small BSSs).**

* + **mechanism to transmit a block ack which contains acknowledgement for data received over multiple links on one or more links.**
	+ **mechanism to transmit block ack requests on one or more links that trigger block acks which include acknowledgement for data received over multiple links.**

**Discussion:**
**C:** slide 8, how can AP in link 1 know that BA is only for link1 or BA is for both link 1 and link2? What is the mechanism? Details mechanism.
**A:** Sequence number is used for it. AP can know that the received BA is for link 1 and link2
**C:** Based on the BA bitmap and sequence number, how can the AP 1 know BA for link 1 and link 2 or only for link 1? Is there any mechanism of signalling?
**A:** Always BA contains the acks for link 1 and link 2. Or BAR indicates that the BA includes ack for link 1 and link2.

1. **1549r1-Multi-link association (Yunbo Li)**

**Summary:**

**Solution 1: two elements related to multi-link**

Multi-band element, and Neighbor report element

**Multiple neighbor report elements are included in Association Request frame**

**Same neighbor report elements are included in Association Response frame**

**Solution 2:**

**Multiple multi-link elements are included in Association Request frame;**

**Same multi-link elements are included in Association Response frame;**

Solution 3:

**On-channel tunneling (OCT) is supported in current spec;**

**On-channel tunneling (OCT) be extended to carry multiple MMPDUs to support MLs**

**Discussion:**

**C:** Slide 4, Regarding Association reponse, Beacon and Probe response can also contain the multi-link information(capabilities,)? It could be duplicated. Maybe overhead
**A:** solution 1 could have duplication. Solution 2 can release it
**C:** why do you include the multi-link element set to N (3) in association response?
**A:** slide 4, just reuse the existing element. This need some indications for it. New element doesn’t need it. Implicit or explicit could be possible

1. **1568r2-Further Discussion on Multi-link Operations (Xiaofei WANG)**
**Summary:**

Dscussion on using a single ID/MAC address to identify MLE and MLD, and include such address in data frames in order to simplify data flows in multi-link operations

* **Option 1: Including the “high” MAC SAP ID in the preamble**
* **Option 2: Including the “high” MAC SAP ID in the MAC header**
* **Option 3: Including the “high” MAC SAP ID in the frame body of a data frame**
* **Option 4: Not include the “high” MAC SAP ID in data frames/PPDUs, instead making the mapping to “high” MAC SAP ID internal within an MLE/MLD**

**Discussion:**

**C:** MAC ID (address) is known for both sides (AP/Client) after association. Why do we need to carry the mapping information in all packets?
**A:** STA/AP both sides knows upper layer information?

C: After association, both side can know upper layer addresses.

A: one assumption. One motion regarding this passed at the last meeting. I don’t now mandatory or not. We can have benefit.
**C:** need to see more. how does it help?
**A:** more discussion during Janunary

**C:** silde 5, at the first bullet, data frame is always in higher layer, why do you mention the ID?

**A:** currently architecture lower mac and higher mac.

1. **1583r0-Multi-Link BSS Operations (Jarkko Kneckt)**

**Summary:**

**discusses some of the major MLME functions for the Multi-Link model:**

* **Pre-association operations**
* **Authentication and Association**
* **Post-association power management**

**Discussion:**

**C:** new link could be added. Does it require new association process?
**A:** single association manages the association. We are open.
**C:** At the last CC, Abhi presents a single association for multiple links. After association, we can enable or disable multiple link by signalling.

**A:** enable and disabling are related to power saving. Need more discussion.
**C:** slide 9, single data indicates unavailability of multiple links. But baseline spec indicates the power saving state independently

1. **1591r2-BA setup for multi-link Aggregation (Jason Yuchen Guo)
Summary:**.

**a simple BA setup scheme for multi-link transmission based on the current the BA setup procedure**

Multiple multi-band element can be put in the ADDBA request and response frames to setup a BA agreement for multi-link aggregation

**Discussion:**

**C:** slide 5, one multiband element is for each link.

A: we can have further optimization. It could be possible.

1. **1617r1-Multi-link power save (Liwen Chu)
Summary:**.
 **Once a link is disabled, no traffic can be transmitted in the link and no power save mode negotiation is done in the link**

The power save mode of different links of a STA MLD can be different.

The power save mode of a link can be announced through another link or the same link.

Buffered frame indication in one link can be broadcasted in another link.

**Discussion:**

**C:** Page 5, why do you use another link to indicate the power state of other link?

A: multilink STA can monitor only one link for power saving. TIM can indicate traffic of other inks.

C: If a STA has a traffic for one link, another link doesn’t need to be used for indicate it. Just send the data on the link.

1. **1550r1-Simultaneous Tx/Rx Cap. indication 4 multi-link op. (Yifan Zhou)**
* **Summary:**. **two methods are provided to indicate the simultaneous Tx/Rx capabilities of link pairs for AP/STA devices.**

**Discussion:**

**C:** close link interference may be propotional to STA’s powers. If STA TX power is low, then OK but if high, STR cannot be supported. That is, STR capability depends on each own TX power. How can indicate that?

A:TX power affects the capability in multilink operation.Two options. one is define maximum TX power in this threshold. Another is different power you indicates in capability. It may be complex but it can work.

C: Agree with gap indication. Receive power as well as TX power should also be considered.

A: Agree

1. **1547r2-Multi-link-operation-and-channel-access-discussion (Kaiying Lu)**

Defered

1. **1615r1-Multi-band/Multi-channel Op. for Low Lat. and Jitter (Liuming Lu)**

Summary:

The combination of multi-link operation, time scheduling and admission control needs to be considered to further lower the latency and jitter so as to satisfy the requirements for RTA.

Flexible channel access methods can be considered for multi-link operation. Different kinds of channel access methods can be respectively adopted for different links according to the environment of the links and the types of the applications loaded on the links

Discussion:

C: in slide 5, how to guarantee the delay in CSMA TXOPs?

A:One is CSMA the other is HCCA. HCCA could be used for delay related traffic.

C: OBSS can use the scheduled TXOP. Any problem may happen by OBSS interference

A: Agree

C: TWT is adopted in 11ax. We can use it instead of this.

 **No other business**

**Adjourned at 21:53 ET.**

**Thursday 09 January 2020, 10:00 – 13:00 ET (TGbe MAC Ad Hoc)**

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Secretary: Jeongki Kim (LG Electronics)

**Introduction**

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	* Jason Yuchen Guo
	* Jeongki Kim (LG)
	* Lei Wang
	* Liwen Chu (NXP)
	* Ming GAN
	* Nader (NEC)
	* Namyeong Kim (LG)
	* Pascal Viger
	* Patrice NEZOU
	* Pooya Monajemi
	* Rojan Chitrakar
	* Sang Kim (LGE)
	* Stephane Baron (Canon)
	* Taewon Song
	* Wisnu Murti
	* Yifan Zhou
	* Yonggang Fang
	* Yongsu Gwak
	* Yunbo Li
	* Wisnu Murti

1. The Chair reminds that the agenda can be found in 11-19/2107r12.

**Submissions**

1. **1633r1-Performance and Fairness of Multi-link Operations (Wisnu Murti)**

**Summary:** introduce several multi-link operations according to power leakage. Synchronous, asynchronous, semi-synchronous operations. Some options for backoff mechanism of semi-asynchronous operation considering fairness issues. And showed the related performance evaluation with simulation results

**Discussion:**
**C:** fairness issues, the legacy 11ac ,80MHz + 80MHz, secondary channel usage is already used and has fairness issue. Free-riding has already existed in the legacy systems. What is contributing for the fairness for multiple primary channel? That is not only 11be issue.
**A:** multi-primary channel and free riding is kind of one system. Cannot say that synchronous uses multiple primary channel. Unfairness causes because of free-riding of multiple primary channel.

**C:** But free riding is already there.80+80, primay 40 and secondary 40 is similar.

**A:** We have to make new channel access worse than that. Using multi-primary and

**C:** more discussion.

**C:** in simulation, what is the power leakage? What CCA method do you use? Use regular CCA or ED? Preamble? What threshold is used for power leakage?

**A:** ED. power leakage is from other link.

**C:** Multilink operation is not worse than before. Introduction of multilink make usage more. Even though problem, …

**A:** frist is similar to abhi. The problem will bring up again. for the second, you need to investigate 3 cases. if preamble is detected, ….

**C:** correct.

1. **1678r0-Multiple-links-asynchronous-and-synchronous-tx (Alan Jauh)**
**Summary:** **propose a mixed asynchronous and synchronous transmission mode. A synchronous group can be an asynchronous multiple link element. Multiple asynchronous links can form a virtual synchronous group and connect to a synchronous group. A single primary link is used for synchronous group.**

**propose a mixed multiple links system that can support mixed configuration and mixed connection**

**Discussion:**
**C:** will be email discussion.

**C:** in case of power leakage, performance is so bad in synchronous, it’s not the practical. ….

**…** you consider the capability in PHY or MAC?

1. **1856r1-A-MPDU and BA (Liwen Chu)**

**Summary:**

The scoreboard context can be updated per the current rules since each link has separate scoreboard context.

The reorder buffer should have different rules:

For block ack agreement that is not a protected block agreement:

For protected block ack agreement, the current rules can be used, i.e. BAR is used to solicit BA only, the robust ADDBA Request is used to shift the WinStartB.

A Block Ack being transmitted in one link can acknowledge the A-MPDU being transmitted in another link in addition to acknowledge the A-MPDU of the link.

**Discussion:**
**C:** slide 7, what is the size of the score board and reorder buffer?
**A:** it doesn’t matter buffer size. Once you transmit the ampdu, the recipient sends a BA.

**C:** you’re assuming the BAR. The received reordering buffer is big enough. If you sets the SC set to 1 then you may not have problem.
**A:** In the future, bandwidth can be increased to 320MHz and SS will be increased to16. BA bitmap and Buffer size may be large. may want to use this big BA bitmap

**C:** Similar of rojan. Slide 6. You re-define the new BAR and add the indicator the WinStartB. If you don’t want …., you just sets the sequence number in the BAR previous BAR. It will solve the problem.

**A:** That’s true. … this behaviour may be 1k or 2k bitmap ... We don’t know because of whether the bandwidth or more Spatial Stream

**C:** slide 5, Own your design rely on the right architecture. I wanna clarify. For left architecture, do we need any change of overall.
**A:** Maybe we have different implementation. But what we want to say here for this multilink operation, we still want to use the current sequence number.

**C:** Any architecture can be used.
**A:** BA is based on the sequence number

1. **1857r1-Multiple link power save followup (Liwen Chu)**

**Summary:**

When multi-link STA entity is in Active mode in link1 and is in power save mode in link2, the multi-link AP entity can request multi-link STA entity in link2 to be in Awake state through the unicast message in link1, e.g. HE Control field.

TIM is used to notify the existing buffered frames in multi-link AP entity for link in Power Save mode

**Discussion: No discussion**

1. **1822r1-Multi-link security consideration (Po-Kai Huang)**
**Summary:**
	1. GTK/IGTK/BIGTK
		1. Same key or different key for different links
		2. Key generation method
	2. PTK
		1. Same key or different key for different links
		2. Key generation method

**propose to have different GTK/IGTK/BIGTK across links to avoid replay attack across links, enable separate security domain, and simplify implementation**

* + **Have one 4-way handshake or group key handshake to deliver the different keys across links**

**propose to have PTK and PN space across links to accompany the design of having one receive reordering buffer across links**

* + Use the MLD address to compute the PMK and PTK

**Discussion:**
**C:** agree with direction. Slide 6, maybe use one single signal. when does it happen? Link has already been setup after assocation?
**A:** Yes. General sequence. Association .. control setup … four handshake. Two handshake update. this is happening after setup.

**C:** Links are enabled. STA may support a lot of links.

**A:** once you set up 3 links, you may want to use two of them. You may use later. You can choose to negotiate every thing at the beginning

**C:** I thin you point that this only happen through one link?
**A:** all happen only one

**C:** slide 7, you mentioned last point reordering buffer

**A:** I agree with you. We have one SN based. One BA agreement. I’ll revise it. a mistake.

**C:** slide 8? we have the same PN space. Is it possible we have same PN space but different PTK across links?
**C:** for same temperal key, PN number should not repeat. it doesn’t mean if we may have same PN space we need to have same PTK.

**A:** Is there reason you want to have same PN space for different key?

**C:** I’m just saying maybe it’s possible to have different...

**C:** the baseline spec in single link we allow multiple PTK

**C:** related contribution.

**A:** maybe I do the SPs after your presentation or other related presentations.

1. **1823r1-Multi-link setup follow up (Po-Kai Huang)**
**Summary:**

**Association is a term used in the current spec for setup between one AP and one non-AP STA**

**Multi-link setup extends the concept for setup between on AP MLD and one non-AP MLD**

**For the multi-link setup between an AP MLD and an non-AP MLD, we expect that multi-link teardown is also required for a non-AP MLD or AP MLD to teardown the setup links**

**provide the detailed procedure for multi-link setup**

* + Non-AP MLD requests the links to be setup
	+ AP MLD accepts one or more links among the links requested by non-AP MLLE for setup or rejects with whatever reason
	+ The link selection above should be implementation specific

**discuss the container for multi-link setup and multi-link teardown**

* + Reuse association request/response and disassociation frame or
	+ Have new management frames for the purpose

**Discussion:**
**C:** slide 4 talk about association. What the authectication…?
**A:** the authentication request and response really thought of …by isolated stuff. Most of .. I talk about the common stuff. Common procedure.. I just focus on the multi-link setup.

1. **1887r0-Multi-link Acknowledgement (Taewon Song)**
* **Summary: Three multi-link ack methods are introduced.** **Per-link acknowledgement, Single aggregated acknowledgement, Single aggregated acknowledgement**
* **Data failure case and ack failure case can be distinguished and thus unnecessary retransmission can be avoided with aggregated acknowledgement**

**Abhi, Zhou, Po-kai, Yongsu, Jarkko**

**Discussion:**
**C:** slide 5, on the STA MLD. This can be used in tight coordination case. Two things. One is what is the architecture of configuration and framework you should be able to support. Two is…, I have the related presentation. We can discuss further next week.
**A:** OK. I have followup presentation for that issue. maybe next week.

**C:** slide 4, similar to abhi, I agree with abhi. STA may have the information of other links in partial state. But this can be adopted in full state.
**A:** …

**C:** New ack policy might be dangerous. Single aggregated ack for other link is …

**C:** concerning on increasing the bitmap size for highest MCS A-MPDUs. Second comment is Tight coordination for AP MLD and non-AP MLD…

**Adjourned at 12:58 ET.**