IEEE P802.11
Wireless LANs

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| Minutes for 802.11 be MAC Ad-Hoc meeting in January 2020 |
| Date: 2020-01-13 |
| Author(s): |
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Abstract

This document contains the minutes for the TGbe MAC ad hoc meetings held in January 2020 (Irvine).

**Monday 13 January 2020, PM2, 16:00 – 18:00 (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 16:00. The Chair introduces himself. The agenda can be found in 20/0131r0
2. The Chair goes through the 802 and 802.11 IPR policy including patent guidelines and procedures and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items and order of MAC Topic.
	* Deferred SPs
	* Backloged submissions
	* New submissions based on order of MAC topic
	* No objection to approve the agenda

**Submissions**

1. **11-19/1116r5, Channel access in multi-band operation (Yunbo Li)**
**SP4: Do you agree to add the followings to the 11be SFD?**
	* **For a MLD that doesn’t support transmission on one link concurrent with reception on another link, when it transmits two PPDUs in these two links concurrently, the end times of the two PPDUs shall be aligned if responses are needed for frames carried in both PPDUs.**

**Discussion:**
**C: in** “shall be aliged” . Does it mean aligned for SIFS or PPDU level? We need a clarification on what aligned is. I don’t see that need.

A: What’s your suggestion?

C: basically aligment means OFDMA symbol level alignment. Here what do you mean? Suggest to change the wording to avoid interference between tx and rx instead of align.

A: OK. SP texts is modified during discussion.

C: Might be complicited

SP is deferred

1. **11-19/**[**1358r2**](https://mentor.ieee.org/802.11/dcn/19/11-19-1541-01-00be-performance-aspects-of-multi-link-operations-with-constraints.pptx)**-** **Multi-link Operation Management (Yongho Seok)**

**Deferred by Author**

1. **11-19/**[**1510r4**](https://mentor.ieee.org/802.11/dcn/19/11-19-1544-00-00be-multi-link-power-save-operation.pptx)**-** **HT Power saving considering multi-link (Jeongki Kim)**

**SP1 and SP2 were deferred.**

**SP3: Do you agree to add the following into the TGbe SFD?**

* 1. For a link between a non-AP STA within a non-AP MLD and an AP within an AP MLD, the non-AP STA of the link can send to the AP of the link a frame to indicate that other non-AP STA(s) within the same non-AP MLD that has(have) entered doze state is(are) in awake state currently

SP result: Y:26, N: 0, A:11

1. **11-19/**[**1526r1**](https://mentor.ieee.org/802.11/dcn/19/11-19-1546-00-00be-legacy-performance-impact-on-multi-link-operation.pptx)**-** **Multi-Link Power-save (Abhishek Patil)**

**Do you support that the 802.11be amendment shall define a mechanism for multi-link operation that enables the following:**

* 1. A non-AP entity monitors and performs basic operations (such as timing information, traffic indication, BSS parameter updates, etc.) on one or more link(s)

**Discussion:**

**C:** Change the entity to MLD

**C:** why does non-AP should monitor any link?

**A:** For power saving, a STA in MLD may not monitor its own link.

**C:** why we need more links? I think one link is enough

**A:** If one linkone link goes wrong, the problem may happen

SP result: Y:27/N:0/A:19

1. **11-19/** [**1528r2**](https://mentor.ieee.org/802.11/dcn/19/11-19-1548-00-00be-channel-access-design-for-synchronized-multi-links.pptx)**-** **Multi-Link Operation - Link Management (Abhishek Patil)**

**SP1 and SP 2 were deferred by yongho request because they are related to his contribution.**

**SP3: Do you agree that each non-AP STA affiliated with a non-AP MLD, that is operating on an enabled link, maintains its own power-state/mode?**

C: One link

C: Change from non-AP STA to non-AP MLD.

A: Here, non-AP STA maintains power states. It does not mean MLD maintains power states of non-AP STAs in the MLD. This is for per-link power state maintenance.

C: Is it it own independent power sate?

A: Yes,

SP texts is changed

C: Power state should be maintained per STA. This is not power managment

SP3 result: Y:29/N:0/A:8

1. **11-19/** [**1536r2**](https://mentor.ieee.org/802.11/dcn/19/11-19-1548-00-00be-channel-access-design-for-synchronized-multi-links.pptx)**-** Power Consideration for Multi-link Transmissions (**Rojan**)

**Author requests to withdraw it**

1. **11-19/** [**1542r**](https://mentor.ieee.org/802.11/dcn/19/11-19-1548-00-00be-channel-access-design-for-synchronized-multi-links.pptx)**1-** Multi-link broadcast addressed frame reception (Po-kai)
* **Do you support that**
	+ a non-AP MLD only needs to follow one link among the links setup with the an AP MLD to receive broadcast addressed frame from the AP MLD
	+ have a TBD mechanism to determine link to receive broadcast addressed frame

C: suggesting the modification

C: One link indicates for STAs to receive the broadcast BU of other link

C: what does the follow mean?

A: You only need to follow one link to receive broadcast frame.

C: follow one link is too strong to me.

C: By the previous Abhi’s passed SP, the non-AP monitors one or more links. Why here STA just follow one link?

C: Text is not clear

C: This is no choice for STA to operate the reception of broadcast frame

A: I added the original text regarding the TBD mechanism to determine the link.

C: need offline discussion.

SP’s deferred.

1. **1544r1 Multi-link power save operation (Minyoung Park)**
* SP1: Do you agree with the following?
	+ For each of the enabled links, frame exchanges are possible when the corresponding non-AP STA of the enabled link is in the awake state.
		- NOTE - A link is enabled when that link can be used to exchange frames subject to STA power states.
		- NOTE - When a link is disabled (i.e. not enabled) by an MLD the frame exchanges are not possible.

**22/0/17**

* **SP2: Do you agree with the following?**
	+ An AP of an AP MLD may transmit on a link a frame that carries an indication of buffered data for transmission on other link(s)

A: link cannot be ps mode but sta can be ps mode

Discussion is deferred later due to out of time.

**recess at 17:57.**

**Tuseday 14 January 2020, PM1, 13:30 – 15:30 (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 13:30. The Chair introduces himself.
2. The Chair goes through the IEEE procedures and the IEEE patent policy and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items.
	* Some people request to consider their deferred SPs in this session
4. The chairman asks for approval of the meeting agenda in 11-20/0131r1.
	* No objection

**Submissions**

1. **1544r2 Multi-link power save operation (Minyoung Park)**

Just capture SP 1 result

* **SP2: Do you agree with the following?**
	+ An AP of an AP MLD may transmit on a link a frame that carries an indication of buffered data for transmission on other link(s)

C: If one link is the active link and the other link is inactive link, then does the active link indicate the buffered data of inactive link?

C: Wrong AP may control the other link.

A: If Non-AP STA doesn’t wants to be controlled by AP, non-AP STA can indicate it to AP

C: when looking at the slide, this is related TID mapping. If TID-to-link mapping is not used, this approach is useless.

A: That’s an example for this. That’s not only usage case. For example, this can be used for load balancing.

SP result: 24/7/20

1. **1548r2 Channel access in design for synchronized multi-links (Yunbo Li)**
* **Do you agree that there is a primary 20MHz sub-channel in each of the multiple links to support dynamic bandwidth negotiation?**
	+ Note: There is a primary 20MHz sub-channel in a link doesn’t imply backoff in the link.

C: primary 20MHz is already used in legacy channel. Here what does it mean?\

C: what kind of functionalites is used for that purpose?

C: it’s already used for channel access in legacy system. What’s the purpose?

A: Just support dynamic bandwidth negotiation

C: today each link has primary channel

A: but I think it can be different in multi-link operation.

C: those operation is in that link or both link?

A: do you think medium access mechanism of each link may be different? If yes, add the note for that.

Note: the medium access mechanism in each link is not yet defined, and may be different from the existing medium access mechanism

the notes is added in the main text

C: how about deleting the orinal text?

13/9/27

1. **1549r3 Multi-link association (Yunbo Li)**

**Which solution do you prefer for ML association?**

* 1. Solution 1: Reuse or extend existing element(s)
	2. Solution 2: New defined Multi-link element (exact name is TBD)

C: instead of association, carry information for multi-link.

A: ML is too broad

C: I don’t wanna use association. Those information could be included in beacon, probe response, etc.

C: why do you extend the elements for this purpose?

C: similar to po-kai, after set up, the information could be included in beacon.

SP text is changed by abhi request

C: SFD doesnot use the ML association. Adding the ML setup.

“setup” is added in the SP text

C: Both solutions could be possible depending on each scenario. Two methods are true

Option1: 0

Option 2: 17

Neither: 7

Abstain: 23

1. **1591r3 BA Setup for Multi-Link Aggregation (Yunbo Li)**
* SP1: Do you support reusing ADDBA request and ADDBA response frames to setup a BA agreement for multi-link operation?

C: How do you set the TA/RA to?

A: Just multi-band element is included. The element carries the information for multiple links. TA/RA is set to the transmitter and receiver of the link. SP1 is high level.

C: why do you reuse the legacy frame? Why not use new action frame?

C: what is exactly SP doing? Please clarify the text.

SP text is changed by author.

**SP1 results: 7/1/38**

* SP2: Do you support to allow ADDBA request and ADDBA response frames to carry multiple multi-band elements to setup a BA agreement for multi-link aggregation?

C: at this time, the previous is enough. This text is not clear to me. Are you clear?

A: you mean it’s too early?

C: why do you use multi-band element? Some information of multi-band element might not be useful.

SP2 is deferred by presenter.

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

Do you agree that admission control could be applied on each link independently?

C: This is similar to operation in the current spec. admission control could be applied on each link

C: it’s hard to answer this straw poll.

C: There is issue in existing device.

C: it can be allowed in any link. We need to differentiate this. This is not per link level but per AP MLD level

**The SP text is changed.**

**Do you agree that ML operation should include admission control mechanism?**

**C: how is the ML operation related to admission control mechanism? Is it allowed?**

**A: yes, it’s for that 11be allows the admission control for multi-link.**

**C: text is not still clear. What purpose is this straw poll?**

**C:in slides, HCCA is admission control. Right? Specify what is admission control mechanism?**

**A: I don’t wanna make it too narrow.**

**5/5/28**

1. **1617r1 Multi-link power save (Liwen Chu)**

**SP1:Do you agree that for a STA MLD each STA on an enabled link maintains its own power save mode/state?**

**C: concept is fine. Need to make one motion text with other SPs later if this passes.**

**C: does this mean that all STAs in MLD maintain its own power save mode?**

**A: all STA doesn’t have same power saving mode. Each STA in MLD can have different power saving mode.**

**C: this is very similar to other passed SPs.**

**SP is skiped**

* **SP2: Do you support that**
	+ **An AP of an AP MLD may transmit on a link a frame that carries an indication of individually addressed frames buffered for transmission on other link(s)**
		- **An non-AP MLD needs to be aware on which link(s) the AP MLD provides the indication**
		- **The mechanism to determine on which link(s) the AP MLD provides the indication is TBD**
	+ **An AP of an AP MLD may transmit on a link a frame that carries an indication of individually addressed frames buffered for transmission on any enabled links**
		- **An non-AP MLD needs to be aware on which link(s) the AP MLD provides the indication**
		- **The mechanism to determine on which link(s) the AP MLD provides the indication is TBD**
	+ **An AP of an AP MLD may be restricted to indicate individually addressed frames buffered for transmission on a link within frame only transmitted on that link**

**C: What is the difference between first and second? Merge them.**

**C: same address or different address?**

**A: link ID**

**SP is changed**

* **SP: Do you support that**
	+ **An AP of an AP MLD may transmit on a link a frame that carries an indication of individually addressed frames buffered for transmission on other enabled link(s)**
		- **An non-AP MLD needs to be aware on which link(s) the AP MLD provides the indication**
		- **The mechanism to determine on which link(s) the AP MLD provides the indication is TBD**
	+ **An AP of an AP MLD may transmit on a link a frame that carries an indication of individually addressed frames buffered for transmission on any enabled links**
		- **An non-AP MLD needs to be aware on which link(s) the AP MLD provides the indication**
		- **The mechanism to determine on which link(s) the AP MLD provides the indication is TBD**

**Y: 5, 7 =12**

**N:3, 1 = 4**

**A:6, 15 = 21**

**12/4/21**

**SP3:**

**C: what is useful or what is this intention?**

**A: TIM mapping?**

**Liwen will update his SP text offline. Will be revisited later.**

**Recess**

**Tuseday 14 January 2020, EVE, 19:30 – 21:30 (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 19:30. The Chair introduces himself.
2. The Chair goes through the IEEE procedure and patent policy and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items.
4. The chairman asks for approval of the meeting agenda in 11-20/0131r2.
	* No objection. The agenda is approved by unanimous consent.

**Submissions**

1. **11-19/1678r0, Multiple Link Asynchronous and Synchronous TX (Alan Jauh)**
**SP1: Do you agree to support mixed synchronous & asynchronous configuration in TGbe multiple links operation?**

**Discussion:**
**C: What is the configuration here? Is it concurrently two mode operated in a MLD?**

**A: This is that a subset of multiple links is synchronous mode and other subset of multiple links is asynchronous mode.**

**C: it seems like that those are already in SFD. The motion related to this passed at Novemeber meeting.**

**SP 1 is skipped by author.**

**SP2: Do you agree to support mixed synchronous & asynchronous connection in TGbe multiple links operation?**

**Discussion:**
**C: what does this connection mean?**

**A: AP should know how to send the data to STA.**

**C: I think this can be possible by capabilities announcement of mult-link**

**3/0/43**

1. **11-19/1822r2, Multi-link security consideration (Po-Kai Huang)**
**SP Deferred**
2. **11-19/1823r1, Multi-link setup follow up (Po-Kai Huang)**
* **SP: Do you support 11be shall define a mechanism to teardown an existing multi-link setup agreement?**

**C: do you want to tear down multi-link setup or multi-link session? I recommend to change from setup to session.**

**A: there is already multi-link setup agreement in SFD**

**C: do you want to use the association procedure? Or new procedure?**

**A: i dont touch the container. Both are possible. First of all, we can define the functionality. And then we can decide the container for it.**

**C: Some people say that it’s multi-link association the other people say that it’s multi-link setup.**

**C:after tearing down, you’re not in the association?**

**A: it means**

**C: do we need to consider to tear down a part of multiple links?**

**C: tear down means no association?**

**A: if tear down the link, then STA can move to other MLD .**

**C: is it possible to go back to legacy mode after tear down?**

**A: it does not mean.**

**C: reassociation or diassociation could be possible for this?**

**A: related to container.**

**Result: 24/2/21**

1. **11-19/1856r1, A-MPDU and BA (Liwen Chu)**

**SP1: Do you support that**

* 1. **Two MLLEs establish a single block ack agreement for a TID through one block ack negotiation.**
	2. **The established block Ack agreement allows the QoS Data frames of the TID, aggregated within the A-MPDUs, to be exchanged between the two MLLEs on any link to which the TID is mapped.**
	3. **The QoS Data frames of the TID transmitted by a MLLE to another MLLE share the same Sequence Number space.**

**C: first and third are already in the SFD**

**A: I can remove them.**

**C: TID mapping does not pass. You don’t need to mention this in second bullet.**

**C: should be ”enabled link”. But available seems like correct.**

**C: Yongho has SP related to TID mapping**

**Modified SP text:**

* **SP1: Do you support that**
	+ **The established block Ack agreement allows the QoS Data frames of the TID, aggregated within the A-MPDUs, to be exchanged between the two MLDs on any available link.**

**11, 9, 10, 30**

**0,0,0, 0**

**3,5,3, 11**

**SP result: 30, 0, 11**

* **SP2: Do you support that**
	+ **for each block ack agreement, there exists one receive reordering buffer based on MPDUs in the MLLE which is the recipient of the QoS Data frames for that block ack agreement.**
	+ **The receive reordering buffer operation is based on the Sequence Number space that is shared between the two MLLEs.**

**C: you need to change to MLD**

**A: OK**

**11, 12, 10= 33**

**0, 0, 0, =0**

**1, 3, 4 = 8**

**33/0/8**

* **SP3: Do you support that**
	+ **The receive status of QoS Data frames of a TID received on a link shall be signaled on the same link and may be signaled on other link(s) ~~where the TID is mapped~~?**

**“where the TID is mapped” is deleted by auther**

**C: how about defering this SP until the SP related to TID mapping is done because it’ not unclear.**

**C: what is the receive status here? Is it bitmap?**

**A:yes. This is BA operation.**

**11, 11,8 = 30**

**1,0,2 = 3**

**3,4,9 =16**

**30/3/16**

1. **11-19/1887r3, Multi-link Acknowledgement (Taewon Song)**

**SP1: Do you agree to add the following text to the TGbe SFD?**

* 1. **TGbe shall support that a STA of an MLD shall provide information on reception of MPDUs received by the STA in a multi-link transmission.**

**C: what is the multi-link transmission?**

**C: the previous passed SP is clearer**

**C: the previous SP is very much similar**

**Go back to deferred SPs**

1. **11-19/1358r3, Multi-Link Operation Management (Yongho Seok)**
* **Do you support the following multi-link operation?**
	+ **Define a directional-based TID-to-link mapping mechanism among the setup links of a multi-link logical device (MLD).**
		- **TID-to-link mapping can have the same or different link-set for each TID unless a non-AP MLD indicates to be required the same link-set for all TIDs in the multi-link setup phase.**
			* **NOTE: Such indication method by the non-AP MLD is TBD (implicit or explicit).**
		- **The TID to link mapping can be updated after multi-link setup through a negotiation, which can be initiated by any MLD.**
			* **Format TBD**
				+ **Note: When the responding MLLE can not accept the update, it can reject the TID link mapping update.**

**A: I changed that TID mapping is adopted to only unidirectional.**

**C: For second subbullet, is this adopted to a non-AP MLD?**

**A: This can be used for AP MLD and non-AP MLD**

**C: the first bullet is during multi-link setup but second bullet is after multi-link setup**

**C: add the default mapping rule. All TID are mapped to all setup link.**

**A: default mapping rule means there is no TID mapping exchange**

**A: Laurent have default mode. I wanna delete this default mode here.**

**C: TID mapping should be set up during multi-link setup.**

**A: already there.**

**C: The MLD setup shall include option to perform the TID-to-link mapping operation**

**C: the multi-link setup may include the TID-to-link mapping negotiation**

**Text is changed**

* **Do you support the following multi-link operation?**
	+ **Define a directional-based TID-to-link mapping mechanism among the setup links of a multi-link logical device (MLD).**
		- **By default, after the multi-link setup, all TIDs are mapped to all setup links.**
		- **The multi-link setup may include the TID-to-link mapping negotiation.**
			* **TID-to-link mapping can have the same or different link-set for each TID unless a non-AP MLD indicates that it requires to use the same link-set for all TIDs during the multi-link setup phase.**
				+ **NOTE: Such indication method by the non-AP MLD is TBD (implicit or explicit).**
		- **The TID to link mapping can be updated after multi-link setup through a negotiation, which can be initiated by any MLD.**
			* **Format TBD**
				+ **Note: When the responding MLD can not accept the update, it can reject the TID link mapping update.**

**SP result: 33/0/22**

1. **11-19/1528r3, Multi-Link Operation - Link Management (Abhishek Patil)**
* **SP1: Do you support defining a link, that is setup as part of a multi-link setup, as Enabled if that link can be used for frame exchange and at least one TID is mapped to that link?**
	+ **Note: frame exchange on a link is subject to the power state of the corresponding non-AP STA**

**C: do we need note?**

**A:it’s just for clarification**

**SP text is changed**

**C: what does the frame exchange?**

**A: if the STA sends PS-poll, it mean awake state.**

**C: can you define the frame exchange?**

**SP result: 27/1/12**

* **SP2: Do you support that the 802.11be amendment shall define signaling, within multi-link operation, to dynamically enable/disable link(s) via a negotiation?**

**C: not clear how to signal of it and it’s not clear to me what use case is for disabling?**

**Text is chaged**

**C: we already agree TID-to-link mapping. Do we need this? There, third bullet mentions this negotiation.**

**C: add the note for the related operation.**

**Out of time**

**Recess.**

**Wednsday 15 January 2020, AM1, 08:00 – 10:00 (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 08:00. The Chair introduces himself.
2. The Chair goes through the IEEE procedures and IEEE patent policy and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items.
	* The agenda is changed by Abhi’s request for considering his SP which did not finish at the last session.
4. The chairman asks for approval of the meeting agenda in 11-20/0131r3.
	* Changed
	* No objection. The agenda is approved by unanimous consent.

**Submissions**

1. **11-19/1528r3, Multi-Link Operation - Link Management (Abhishek Patil)**

**SP2: Do you agree that a link can be dynamically enable/disable link(s) as a result of TID to link mapping?**

* + **Note: Signaling TBD**

**C: we already agree two SPs for TID mapping. I think we don’t need this**

**A: This is dynamically to change the link status**

**Deferred**

1. **11-19/1901r3, Priority Access Support in IEEE 802.11be: What and Why?, Subir Das,**

**Do you support adding to TGbe SFD that**

**the 802.11be amendment shall define mechanism(s) in support of priority access to a NS/EP Priority Service non-AP STA**

**Note: NS/EP Priority Service non-AP STA is a regular non-AP STA that is authorized to access the AP**

**C: how does it know priority access non-AP STA? change the text.**

**C: what does it mean “ authorized to access to the AP”? association? Then change the note?**

**C: what is the priority access? Is it AC?**

**A: no details. Could be new AC.**

**Text is changed**

1. **11-19/1510r5, EHT Power saving considering multi-link, Jeongki Kim,**
* **Do you agree to add the following into the TGbe SFD?**
	+ For multiple links between an AP MLD and a non-AP MLD, the TWT agreement on a link among the multiple links may be set up on another link among the multiple links
		- The details (e.g., frame/element format, STA/AP operation, etc.) are TBD
		- Note: The TWT agreements on different link might not have common timing reference

SP result: 22/9/30

1. **11-19/1899r2, MLA MAC Addresses considerations, Duncan Ho**

**Summary:**

* + **The MAC addresses sent OTA are the link MAC addresses**
	+ **AP MLD uses different MAC addresses on each link**
	+ **Non-AP MLD may use same or different MAC addresses on each link**
	+ **An MLD address may be the same as one of the MAC Addresses of the STAs that are affiliated with the MLD**

**C: nounce is per link. How do you generate the PTK for multiple links?**

**C: MLD should have the same MAC address**

**C: slide 6, what is the link MAC address? Is it TA/RA or BSSID?**

**C: it’s natural to have different color for different BSSs.**

**C: A1 uses link address or MLD address? Is it remapped?**

**A: link address, AP has to translate**

**C: why do you want to use different MAC addresses in a MLD? All legacy STA stays in a single link. What is the advantage of different address in AP MLD?**

**A: why do you mandate this? There is no impact on legacy STA**

**C: when refreshing PN or security, might have issue.**

**C: slide 9, the first bullet is internal mapping.**

**SPs are deferred.**

1. **11-19/1900r3, MLA Security Considerations, Duncan Ho**

**Summary:**

* **For MLA Operation, we presented some security issues associated with unicast and group-addressed frames that are specific to MLA operation**
* **We presented some options to solve these issues for MLA**

**C: slide 10, which part do you want to puncture?**

**A: A2 will be punctured in silde 8**

**C: among two option, you wanna option 2?**

**A: Yes**

**C: slide 7, agree with GTK. In option 1, using different GTK/IGTK doesn’t have any issue.**

**SPs are deferred**

1. **11-19/1822r2, Multi-link security consideration, Po-Kai Huang (SP)**
* **SP1: After multi-link setup between two MLDs, do you support to use different GTK/IGTK/BIGTK in different links with different PN space?**
	+ **GTK/IGTK/BIGTK in different links are delivered in one 4-way handshake**

**C: This is for GTKs. How about PTK?**

**A: SP2 has the thing for PTK. It’s defered by other request**

**SP result: 30/2/21**

**Recess**

**Wednsday 15 January 2020, PM2, 16:00 – 18:00 (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 16:00. The Chair introduces himself.
2. The Chair goes through the IEEE procedures and IEEE patent policy and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items.
	* **Call meeting to order**
	* **IEEE-SA IPR policy and Procedure**
	* **Set and approve agenda**
	* **Presentation of submissions (back-logged Low Latency** **and ML architecture)**
		+ 1622r0 - Use Auto Repetition in low latency queue, Tony Zeng
		+ 1938r0 - Discussion on low latency capability for 802.11be, Kazuyuki Sakoda
		+ 1942r3 - Timing Measurement for Low Latency Features, Akira Kishida
		+ 1960r1 - Reducing Channel Access Delay for RTA Traffic, Mohamed Abouelseoud
		+ 1921r0 - Multi-link architecture, Ming Gan
		+ 1962r0 - ML Upper-MAC Entity Inst. & New Frame MAC Header, Huizhao Wang
		+ 1963r0 - Multi-Link Security And Aggregation Operations, Huizhao Wang
4. The chairman asks for approval of the meeting agenda in 11-20/0131r4.
	* No objection. The agenda is approved by unanimous consent.

**Submissions**

1. **11-19/1942r7,** Timing Measurement for Low Latency Features, Akira Kishida

**Summary:**

* To obtain more detailed availability of low-latency and jitter features, additional measurement function(s) for contention time, retransmission time will be needed.
	+ To judge whether current RTA is applicable or not, statistical information about latency and jitter should be measured and notified as well.
* To control low-latency features in 11be properly, RTA STAs should have latency measurement and notification features.
	+ However, concrete method of latency measurement will be implementation matter.

C: do you need a detailed value of each time (e.g., wating time, contention time, ..)?

C: Are those the application value?

C: need a concret solution for this purpose

A: how measurement can be used for latency

C: measurement report (e.g. queue delay, tspec) already is in the spec. do you want to make new measurement or etc.)

A: agreement for improving measurement is important

C: are you looking for others for latency measurement?

A: serveral paramenters exist but they don’t seems to be enough

**SP deferred**

1. **11-19/**1938r0 - Discussion on low latency capability for 802.11be, Kazuyuki Sakoda

Summary: The author introduces the re-defintion of Queuing and scheduling delay, Channel access delay, Retransmission delay for 11be system

C: multi-link or multi-AP coordination could be release the latency as well.

A: we do need more simulation.

C: 5G has scheme for very lower latency. For competition, this approach is very good

C: I don’t think we preclude ….

C: we need to look at general mechanism for this. Multi-link, multi-AP, etc. could be good candidates

A: agree.

C: in the future, BSS model can be changed such AP coordination stuff.

C: The latecy depends on the network situation

* **SP1: What should be our intra-BSS latency target for real-time application?**
	+ ~1 msec (Typical application: Motion control with safety constraints)
	+ 5~10 msec (Typical application: Gaming / Real time video)
	+ ~100msec (Typical application: Remote control)

C: This value might not be proper due to OBSS interference

A: I think this is reasonable although OBSS interference exists

C: which latecy are they? Bounded latency or average latency?

A: Bounded latency /worst case latency

C: what is the purpose of this SP? Just getting information or going to SFD? Already they are in the PAR.

A: Not for SFD but getting information

C: I wonder how we can meet this value.

C: concern on the average latency target. The worst case latency might be better

C: We had already discussed this issue during old meetings, RTA TIG, during PAR creation. At that time we decided not to make the exact value. Why do you want it?

**SP result: 36/4/17**

1. 1960r1 - Reducing Channel Access Delay for RTA Traffic,Mohamed Abouelseoud**,**

**Discussion:**

**Minimizing channel access delay is important to limit the worst case latency and jitter over WLAN**

**For frequent RTA traffic, persistent resource allocation can help in limiting worst case latency and jitter**

**For small and periodic RTA traffic, the STA knowing the expected time of RTA packets arrival can limit the channel access delay by contending for channel access before the expected arrival of the RTA packet**

**C: I don’t think it might be right direction. This could hurt the legacy STAs**

**C: it sounds like jamming. It could be issue.**

**C: Concern is similar to previous commenter**

**C: there may be regulation issue.**

**Not run SP**

1. 1921r0 - Multi-link architecture, Ming Gan

**Only discussion not running SP**

**Recess**

**Thursday 16 January 2020, AM1, 08:00 – 10:00 (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 08:00. The Chair introduces himself.
2. The Chair goes through the IEEE procedures and IEEE patent policy and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items.
	* **Call meeting to order**
	* **IEEE-SA IPR policy and Procedure**
	* **Set and approve agenda**
	* **Presentation of submissions (back-logged ML Link Management)**
		+ **1904r0 - MLO: Link Management (follow-up), Abhishek Patil**
		+ **1924r0 - Multilink – steps for using a link, Laurent Cariou**
		+ **1930r1 - AP assisted Multi-link operation, Dibakar Das**
		+ **1932r0 - Multi-link policy framework, Cheng Chen**
		+ **1943r1 - Multi-link Management, Taewon Song**
	* **Adding the deferred SPs (1899r4)**
4. The chairman asks for approval of the meeting agenda in 11-20/0131r5.
	* No objection. The agenda is approved by unanimous consent.

**Submissions**

1. **11-19/1899r4, SP only, MLA MAC Addresses considerations, Duncan Ho**

SP1: Do you support the following?

* The value of the RA/TA fields sent over-the-air in the MAC header of a frame is the MAC address of the STA affiliated with the MLD corresponding to that link

C: Are you gonna running the SP2 also? I want that SP2 first is discussed

SP2: Do you support the following?

* An AP MLD uses different MAC addresses on each STA affiliated with it

C: Is this only way? Could or shall?

A: Yes, this is only way to solve the problem

C: Depending on the scenarios, the solution could be diffierent. This is very general. I think there is no issue for discovery on the non-AP side.

C: The contribution does not include many reason to include this for that purpose. This is only for non-colocated case. But it may be different for collocated case.

C: slide 6, this should be fine. In some scenario, the same address could be fine in AP MLD

C: This SP has multiple impliciations to me. What detailed scenarios can this be used in?

A: One AP to multiple scenario could be used. Not one single physical device. This is for multi-link

C: The MAC address should be in TA

A: Next SP includes it

C: OK

C: shall or may?

A: shall. Text is chaged

C: change the STA to AP STA

Text is modified

SP2 results: 32/14/20

1. **11-19/1904r1, MLO: Link management–follow up,** **Abhishek Patil**
* **Summary: provides a clear delineation between link mapping and power-states of each link**
	+ **Introduces the concept of a default link where the non-AP MLD, at the least, monitors APs beacons**
	+ **Each non-AP STA instance performs transition to doze state based on activity on its affiliated link**
	+ **Introduces cross-link wake-up signaling**

**C: is this related to multi-link management? I think all are regarding power saving.**

**A: This is for clearness between link mapping and power states.**

**C: Similar feeling. Most of slide are related**

**C: default link is for a single STA or for all STAs of MLD**

**A: default link is for per non-AP MLD**

**A: This is for discovery of the unassociated STA**

**A: detailed operation will be discussed next time.**

**C: which link is enabled or disabled should be up to non-AP STA**

**C: TID-link-mapping is optional.**

**C: I don’t think non-AP STA doesn’t need to report its default link but just picks it up. But you want to mandate for STA to report it to AP**

**C: SP 1 is not related to those operation. Please focus on the SP 1 text.**

**C: we need more deterministic approach.**

**C: SP 1 is similar to previsous passed SPs related to TID link mapping by yongho**

**C: for SP3, I think that minyoung’s SP (buffered traffic indication) is enough.**

**C: how about changing the text to recommend for non-AP MLD to use the other link**

**C: for lower latency, I think this SP is necessary.**

**SP 3 text is changed**

* **SP3: Do you agree that an AP MLD can recommend a non-AP MLD to use one or more links?**
	+ **The AP’s indication could be carried in a broadcast or a unicast frame**

**SP3 result: 42/0/19**

1. **19/1924r0 - Multilink – steps for using a link, Laurent Cariou**

**C: SP1 is very similar to yongho’s SP**

**C: TID to link mapping is TXOP based? For example if transmission is finished, no information any more?**

**A: Mapping states is long term**

**C: TID link mapping could be different between DL and UL**

**A: yongho’s contribution already mentioned it. For default link, they will be same**

**C: in SP 2 for MU, accoss the links? MU links could be independent?**

**A: could be independent?**

**C: for single link case, AP can do admission control. In that case, you don’t need SP2**

**A: OK, I will modify the text with unless admission control is used**

**C: do you want to use admission control 11be?**

**SP2 text is changed**

* **SP2: Do you agree to add the following to the specification framework document:**
	+ **At any point in time, a TID shall always be mapped to at least one link that is set up, unless admission control is used**

**SP2 result: 27/2/26**

* **SP3: Do you agree to add the following to the specification framework document:**
	+ **~~A link is enabled when that link can be used to exchange frames subject to STA power states, and when at least one TID is mapped to that link~~**
	+ **When no TIDs are mapped to one link, that link is disabled. a link is disabled (i.e. not enabled), the frame exchanges are not possible**
	+ **Management frames are allowed on all enabled links, unless explicitly restricted**
	+ **~~Including a Direction-based TID-link mapping~~**

**SP text is changed.**

**C: management is mapped to AC\_VO. I don’t know what the second bullet means.**

**C:**

Will continue to discuss in next session

Recess

**Thursday 16 January 2020, AM2, 10:30 – 12:30 (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 10:30. The Chair introduces himself.
2. The Chair goes through the IEEE procedures and IEEE patent policy and asks if there is anyone that is aware of any potentially essential patents. Nobody speaks up.
3. The Chair reviews the proposed agenda items.
	* **Call meeting to order**
	* **IEEE-SA IPR policy and Procedure**
	* **Set and approve agenda**
	* **Presentation of submissions (back-logged ML Medium Access, MAC channel access)**
		+ **1924r0 - Multilink – steps for using a link, Laurent Cariou (SP #2, Y: 27, N: 2, A: 26)**
		+ **1547r3 - Multi-link-operation-and-channel-access-discussion, Kaiying Lu**
		+ **1836r2 - Multi-link Channel Access Follow-up, Sharan Naribole**
		+ **1917r0 - Considerations for ML channel access without simultaneous TX/RX capability, Insun Jang**
		+ **1993r0 - Discussion about single and multiple primary channels in synchronous multi-link, Yunbo Li**
		+ **2071r1 - Perf. eval. of Multi-link channel access schemes, Sindhu Verma**
		+ **1604r0 - EHT Direct Link Transmission, Dibakar Das**
		+ **Adding the deferred SPs (1899r4 and 1542r2) and firstly go through them**
4. The chairman asks for approval of the meeting agenda in 11-20/0131r7.
	* No objection. The agenda is approved by unanimous consent.

C: is there any time limit for presentation and discussion.

A: if memeber want it, i’ll do it (25min per each presentation)

**Submissions**

1. **11-19/1899r4, SP only, MLA MAC Addresses considerations, Duncan Ho**

**SP 1: Do you support the following?**

* The value of the RA/TA fields sent over-the-air in the MAC header of a frame is the MAC address of the STA affiliated with the MLD corresponding to that link”

C: merge the texts

C: different from texts of r4, please upload the revision.

 SP1 result: 23/0/14

 **SP2: “Do you support the following?**

* The MAC address of each affiliated AP within an AP MLD shall be different from each other unless the affiliated APs cannot perform simultaneous Tx/Rx operation (e.g., due to near band in-device interference), in which case the MAC address properties are TBD“

 C: the MAC address of non-AP STA is the same?

 A: SP3 mentioned it. This is general

 A: This is not regarding the same or different address. Only RA/TA is set to the MAC address of the STA

 SP2 result: 29/2/12

1. **11-19/1542r2, SP only, Multi-link Broadcast Addressed frame Reception, Po-kai Huang, Intel**
* **SP: Do you support that**
	+ a non-AP MLD that wants to receive all broadcast addressed Data frames is allowed to receive broadcast addressed Data frame from a link among the links setup with an AP MLD
	+ The link used by the non-AP MLD to receive broadcast addressed Data frame can be changed, and the method to change the link is TBD

C: what is the purpose? Only receive broadcast addressed frame from a link? Non-AP STA should receive broadcast address frames from one link?

C: how do I know which link?

Time out.

SP deferred

1. 1924r0, SP only, **Multilink – steps for using a link, Laurent Cariou**

**SP3: Do you agree to add the following to the specification framework document:**

* + Management frames are allowed on all enabled links, unless explicitly restricted

SP text is changed as follows:

* **Management frames are allowed on all enabled links, following baseline**

SP3 result: 28/0/15

SP4: **Do you agree to add the following to the specification framework document:**

* + If a TID is mapped in UL to a set of enabled links for a non-AP MLD, then the non-AP MLLE can use any link within this set of enabled links to transmit data frames from that TID
	+ If a TID is mapped in DL to a set of enabled links for a non-AP MLLE, then:
		- the non-AP MLLE can retrieve buffered BUs corresponding to that TID on any links within this set of enabled links, provided that a link is enabled in UL for the non-AP MLLE to indicate a request for delivery
		- The AP MLLE can use any link within this set of enabled links to transmit data frames from that TID, subject to existing restrictions for transmissions of frames that apply to those enabled links

C: it seems STA has different TID link mapping from DL

C: could you split DL and UL? Not clear for the first bullet in DL. For DL, is there any restriction?

C: concern on DL.

A: I can remove the “provide that …”

It’s deleted.

SP text is changed from r0 as follows:

**SP4 (modified) : Do you agree to add the following to the specification framework document:**

* If a TID is mapped in UL to a set of enabled links for a non-AP MLD, then the non-AP MLD can use any link within this set of enabled links to transmit data frames from that TID
* If a TID is mapped in DL to a set of enabled links for a non-AP MLD, then:
	+ the non-AP MLD can retrieve buffered BUs corresponding to that TID on any links within this set of enabled links
	+ The AP MLD can use any link within this set of enabled links to transmit data frames from that TID, subject to existing restrictions for transmissions of frames that apply to those enabled links
		- An example of restriction is if the STA is in doze state

SP4 result: 14/0/23

1. **1547r3 - Multi-link-operation-and-channel-access-discussion, Kaiying Lu**

C: contraints is important to AP and STA. we have some contributions on this. Let’s discuss more with it.

C: why is this constaints applied to AP? AP can choose the channels which are enough far from each other.

A: it depends on the scenarios or the AP tx power

C: If AP chooses the channels with constraints, how is the performance?

C: If AP has constraints, is the channel access similar to single link operation like 80+80MHz.

A: Yes, it might be similar

C: slide 4. How does the AP decide which channel is primary channel?

A: link 2 have some constraints

C: why does AP MLD choose constrained channels? This is same as 80+80MHz. Performance of this will be smaller than AP with non-contrained channels.

C: legacy device can use only one link or 80+80 using two links?

A: only using one link

C: slide 6, single link STA does not use link 2. What is the gain or benefit?

A: This is related to the channel access

 SP is deferred

1. **1836r2 - Multi-link Channel Access Follow-up, Sharan Naribole**

C: slide 5, concern on a single ack aggregation for other links

A: it will be beneficial

C: the standard already supports the different architectures.

C: for STT constaints of non-AP, only one ACK is transmitted, how can the TXOP be protected?

C: do you have simulation results? What is the benefit of these?

A: already respond it.

C: slide 5, there are many waste. The start time is same but end time is different. It may be complex. And worry about cross link Ack.

C: why do you align the start time? You don’t need it. I’d like to show the STT reason, the related Ack contraints

A: In some cases, STA may have STT constraints

SP is defered

1. **1917r0 - Considerations for ML channel access without simultaneous TX/RX capability, Insun Jang**

Couldn’t have any discussion due to out of time

Please send author e-mail if you have question or comment on this

Adjourn at 12:30pm