IEEE P802.11
Wireless LANs

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| ARC SC teleconferences minutes 2 and 4 Nov 2020 - Plenary |
| Date: 2020-11-02 |
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Abstract

This document contains the minutes of the IEEE 802.11 ARC SC teleconference held on 2 November 2020 at 13:30-15:30 h ET and 4 November 2020 at 11:15-13:15 h ET.

Note: Highlighted text are action items. A- precedes comments from the document’s author, C- precedes comments, R- precedes responses to comments

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# Monday 2 November 2020, 13:30-15:30 h ET

## Administration

**Chair: Mark Hamilton, Ruckus/CommScope**

**Vice Chair: Joseph Levy, InterDigital**

**Secretary: Joseph Levy, InterDigital**

**Meeting called to order by the Chair 13:33 ET**

Agenda slide deck: [11-20/1696r2](https://mentor.ieee.org/802.11/dcn/20/11-20-1696-02-0arc-arc-sc-agenda-nov-2020.pptx) proposed agenda copied here for reference (will be r3 out of the meeting):

**ARC Agenda – 2 Nov 2020, 13:30 ET**

* **Reminder: 2 meetings this week: 2 Nov 13:30 ET, 4 Nov 11:15 ET**
* **Attendance, noises/recording, meeting protocol reminders**
* **Policies, duty to inform, participation rules**
* **Prior meeting minutes**
* **Note plan for TGbc teleconferences – Nov 17 and 24, during TGbc meetings**
* **Status of** [**11-20/0177r4**](https://mentor.ieee.org/802.11/dcn/20/11-20-0177-04-0arc-liaison-to-revmd-on-ess.docx) **(liaison to REVmd)**
* **Contributions:**
	1. **802.11 TGbe’s evolving multi-link architecture contributions**

**ARC Agenda – 4 Nov 2020, 11:15 ET**

* **Attendance, noises/recording, meeting protocol reminders**
* **Policies, duty to inform, participation rules**
* **Note plan for TGbc teleconferences – Nov 17 and 24, during TGbc meetings**
* **Contributions:**
	1. **802.11 TGbd architecture concepts (< 0.5 hour)**
	2. **802.11 TGbe’s evolving multi-link architecture contributions (1.5+ hour)**
* **Next steps**

**Call for Patents:**

The Chair reviewed the Patent policy and called for potentially essential patents – there was no response to the call.

**Participation:**

The chair reviewed the participation policy

**Approval of the Agenda:**

**ARC Agenda – 2 Nov 2020, 13:30 ET**

* **Reminder: 2 meetings this week: 2 Nov 13:30 ET, 4 Nov 11:15 ET**
* **Attendance, noises/recording, meeting protocol reminders**
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* **Contributions:**
	1. **802.11 TGbe’s evolving multi-link architecture contributions**

**ARC Agenda – 4 Nov 2020, 11:15 ET**

* **Attendance, noises/recording, meeting protocol reminders**
* **Policies, duty to inform, participation rules**
* **Note plan for TGbc teleconferences – Nov 17 and 24, during TGbc meetings**
* **Contributions:**
	1. **802.11 TGbd architecture concepts (< 0.5 hour)**
	2. **802.11 TGbe’s evolving multi-link architecture contributions (1.5+ hour)**
* **Next steps**

The Chair reviewed the agenda and called for comments or amendments to the agenda - there was no response to the call.

The proposed agenda was accepted by unanimous consent.

## Approval of Minutes:

Agreed to modify the agenda and moved to Wednesday.

## Status of [11-20/0177r4](https://mentor.ieee.org/802.11/dcn/20/11-20-0177-04-0arc-liaison-to-revmd-on-ess.docx) (liaison to REVmd) – slide 19

Chair - Reviewed the status of the LS. After second review TGmd did not accept the proposed changes.

Chair – Reviewed the proposed changes to IEEE Std 802.11.

There were no comments.

Way forward: this item will be proposed for TGme.

##  802.11 TGbe’s evolving multi-link architecture contributions

Chair provided an overview of the documents to be discussed, a call was made for additional contributions.

[**11-20/1639r2**](https://mentor.ieee.org/802.11/dcn/20/11-20-1639-02-00be-11be-ap-mld-architecture-discussion.pptx) **- 11be AP MLD Discussion - Mark Hamilton**

Presented by Mark Hamilton. This document considers the previous discussions held in the ARC SC session on 6 August, 24 August, 16 September, and 19 October; hence there has been quite a bit of discussion on the topics discussed in this document. The document provides some additional TGbe agreements, relative to r1 (based on TGbe passed motions) and is focused on the AP as a first step to better understand MLO and MLD requirements and 802.11 architecture impacts. Goal is to put all the discussion in one place and to ensure a consistent understanding of the architecture.

A – (Slide 3) this slide is just for the AP MLD.

A – (Slide 4) TGbe motion text has been added.

A – (Slide 5) Regarding retransmission, retransmission is not completely defined by TGbe, hence this cannot be completed until TGbe has completed this work. Also, discussed 2nd SP – which has not been run. But TGbe is where this decision will be made.

C – Using the MLD MAC address will not allow for the ability to control the reuse of the nonce when repeating a link 1 message on link2.

R – Why would the nonce not be controlled at the MLD level? This issue is not clear.

C – In the current design – there is per link management – but this should be a TGbe decision. How do make sure management frames are taken care of?

R – How are “legacy” vs. MLD level management frames handled in the current design.

R – This is a key component – it is more in the TGbe side – but we need to consider the security issues. This has issues with broadcast management frames. We need to consider both group management frames, and individually addressed frames. After a TGbe discussion, there may be a place to have an ARC discussion.

R – Has this topic been captured in TGbe?

R – There is no list of open items in TGbe, TGbe is contribution driven, there are some TBDs in the current draft.

A – (Slide 6) Block-ack scoreboarding - is implementation specific.

There were no questions or comments regarding the scoreboarding statement above.

A – (Slide 7) reviewed status

C – Regarding Address 1, address 1 is critical for the MAC to know what to do with the frame.

A – Supporting logic of the approach, but it is not clear how this will work in TGbe at this point.

C – (Slide 8) Some discussion on PS states on the different links.

A – Is it true that the only time when buffering occurs is when all links are in doze.

R – For link specific transmission buffering is for everything. For data it is reasonable for buffering only when all links are in doze. But for broadcast frames, it may be different.

A – (Slide 8 cont.) – continuing the MLD level and Per-link level discussion, concern about the header creation/validation functions – as how these are handled may be tricky.

R – A lot is currently done with the header today, not masked header, need to consider AAD construction.

A – (Slide 9) Based on the previous discussion of the “agreements” and the split is shown in Slide 9 does this work?

C – Does this maintain the convention of the sequence of order of operation?

A – The intent is to maintain the order of operation, but it is implementation dependent. There is no intent to change the order.

A – (Slide 10) Figure 5.1 is just the data plane, but management plane interacts with the data plane. Historical discussion. The figure is using the current management philosophy.

C – (Slide 11) Where you show management frames is that all of them or a subset.

A – A subset.

C – Should the adding non-MLD frames also be considered.

A – non-MLD frames are considered on the next slide – lets discuss it then.

C - Some frames need to be link level, and others not, sounding needs to be delt with on a per link level. NDP is not a control frame – but it should be delt with on a per link level.

A – Believe, all NDP frames are at the per link level.

C – OMN could be link specific.

C – Supporting the concept of address 1 filtering.

A – Also the frame type really is important in routing.

A – (Slide 12) There is no need for a whole new structure for the MAC stack.

C – Clarifying: legacy behavior is handled by the current picture in the spec and MLD behavior is added in as shown.

A – There is no need for a new figure, the stack can handle different peers.

C – The different stations have different boxes; did you add additional stacks to add functionality?

A – Every packet just goes through path shown in the figure.

C – Legacy just comes through one link, and MLO has multiple routes for data.

A – For the MLD case there is logic and intelligence that controls which links the AP MLD uses to send the data to non-AP MLD. The decision of which links to use is made by the routing decision. There is no need to add any additional functionality to the figure.

C – Does this mean that the figure is for MLD and for MLD to MLD and there is only one location for routing?

C – Is the AP MLD handling multiple peer devices are there disallowed combination?

A – That is a critical question which this figure has helped raise.

C – An MLD takes only one association request/response. So, there must be some other aspects with respect to how these links work.

A – In legacy you can reassociate – these would have different replays and counters – there are multiple cases shown in the figure of legacy and MLD – it is all in the same figure.

A – reassociation need to be considered.

C – The legacy figure is already in the specification; it will not be deleted – we should just refer to the legacy figure.

A – If legacy is just gluing this figure and the legacy stack together that would work. But only the legacy is sending the beacons – hence this new stack must be aware of the legacy beacons. Where do these stacks connect? We probably do not need a second stack. An AP MLD would use this figure and not the old figure. If there is something missing, we should add it to this figure.

C – Why are we identify all the differences?

A –To clarify how things work.

C – How we are sharing state between the legacy and MLO, using ordinary state machines, this needs to be broken down and made clear. What is the state of the legacy and MLO at any given time? How are stations tracked, how do they receive keys? The overall state of the MLD gets quite complex and may be different than the legacy state. Binding the MLD station to one of my links, seems to be the cleanest for an implementation. The state of the MLD and legacy and how they interact is very interesting.

C – How does this work, the legacy has this beacon stuff under multiple BSS id and the beacons may be sent by a different BSS? This is complex.

A – Eventually we do need to get some understanding of the whole SME and its state. This figure and discussion is a first step in trying to build that understanding. Based on this discussion I think we now better understand where we need to build.

[**11-20/1122r3**](https://mentor.ieee.org/802.11/dcn/20/11-20-1122-03-00be-802-11be-architecture-association-discussion.pptx) **– 802.11be Architecture/Association Discussion – Joseph Levy**

* Presented by Joseph Levy. This document references the 802.11 and 802 reference models and “basic stack”, and notes that 802.1AX’s concept of link aggregation is already done – so link aggregation above the MAC SAP is available and outside the scope of 802.11be. It then considers 802.11’s data plane architecture (current, non-GLK) for a high-level view of an AP and non-AP peer pair. 802.11be is adding multiple links and PHYs (slide 8). Skip to slide 11.
* Slide 11, shows how MLD/MLO is different (from 802.1AX, or legacy 802.11): MLO is an efficient way to do aggregation within 802.11, allowing improved latency, throughput, etc. MLD device still supports legacy behavior, when paired with a legacy peer.
* Slide 12 Discusses how combinations of definitions leads to confusion. Slide 13 proposes to define AP MLD as a particular type of AP. Likewise, a non-AP MLD to be a type of non-AP STA. That is, AP MLD is an AP with multiple PHYs, and we add the multi-PHY behavior (only) to the standard, the rest of the AP (or non-AP) text can stay as-is.
* Slide 14: Straw Polls to be run in TGbe…
* Slide 15: Clean up concepts of “link” and “device”. Slide 16: Straw Polls to be run in TGbe, on slide 15 concepts.

C – Mostly agree with the concerns. But, not sure about new definition of AP. Consider how we describe the legacy STA’s view: is a 2.4 and 5 GHz AP MLD 1 AP, or 3, or …?

A – How many concepts are within a device is a question beyond the 802.11 spec. The MLD logical SAP-to-SAP connection device is one entity. Other APs in the device are different logical entities.

C – Struggling with a multi-PHY link. There is separate channel access with MLO links. That means there are logical separations of concepts between the links.

A – Channel access is really a PHY layer function (conceptually) and is not in the MAC stack diagram(s).

C – Another example, power save is a per-link feature, but it is a MAC feature. Need to make this clearer that it is more than multi-PHY, it is more than that.

Ran out of time to consider further or consider the straw polls (just for ARC comment, anyway, as these are TGbe straw polls).

## Recess 15:30 h EDT

# Wednesday 4 November 2020, 11:15-13:15 h ET

## Administration

**Chair: Mark Hamilton, Ruckus/CommScope**

**Vice Chair: Joseph Levy, InterDigital**

**Secretary: Joseph Levy, InterDigital**

**Meeting called to order by the Chair 11:17 ET**

Agenda slide deck: [11-20/1696r4](https://mentor.ieee.org/802.11/dcn/20/11-20-1696-04-0arc-arc-sc-agenda-nov-2020.pptx) proposed agenda copied here for reference (will be r3 out of the meeting):

* **Attendance, noises/recording, meeting protocol reminders**
* **Policies, duty to inform, participation rules**
* **Prior meeting minutes**
* **Note plan for TGbc teleconferences – Nov 17 and 24, during TGbc meetings**
* **Contribution/discussion topics:**
	1. 802.11 TGbd architecture concepts (< 0.5 hour)
	2. 802.11 TGbe’s evolving multi-link architecture contributions (1.5+ hour)
* **Next steps**

**Call for Patents:**

The Chair reviewed the Patent policy and called for potentially essential patents – there was no response to the call.

**Participation:**

The chair reviewed the participation policy

**Approval of the Agenda:**

* **Attendance, noises/recording, meeting protocol reminders**
* **Policies, duty to inform, participation rules**
* **Prior meeting minutes**
* **Note plan for TGbc teleconferences – Nov 17 and 24, during TGbc meetings**
* **Contribution/discussion topics:**
	1. **802.11 TGbd architecture concepts (< 0.5 hour)**
	2. **802.11 TGbe’s evolving multi-link architecture contributions (1.5+ hour)**
* **Next steps**

The Chair reviewed the agenda and called for comments or amendments to the agenda - there was no response to the call.

The proposed agenda was accepted by unanimous consent.

## Approval of Minutes:

***Note: moved from Monday***

**September 16 telecon**

Move to approve the:

September 16 Telecon Minutes in: [**https://mentor.ieee.org/802.11/dcn/20/11-20-1486-00-0arc-arc-sc-teleconference-minutes-16-sept-2020-interim.docx**](https://mentor.ieee.org/802.11/dcn/20/11-20-1486-00-0arc-arc-sc-teleconference-minutes-16-sept-2020-interim.docx)

Called for comments.

Approved by unanimous consent.

October 19 telecon minutes in: <https://mentor.ieee.org/802.11/dcn/20/11-20-1674-00-0arc-arc-sc-teleconference-minutes-19-oct-2020.docx>

Called for requests for more time to review.

Called for comments.

Approved by unanimous consent.

## 802.11 TGbd architecture concepts (< 0.5 hour)

[**11-20/1166r4**](https://mentor.ieee.org/802.11/dcn/20/11-20-1166-04-00bd-ngv-11bd-architecture-discussion.pptx) **– NGV 11bd Architecture Discussion – Joseph Levy**

* This document has been reviewed earlier this week, by TGbd. Overview: TGbd uses the OCB architecture (from 802.11p), and can support ITS, including IEEE 1609. There are no planned changes to OCB concept or behaviors. This seems to imply no architecture changes to 802.11 are needed.
* However, there are items of potential interest to ARC group, to “clean up” the MAC service to better support ITS and IEEE 1609 (slides 5 and 6):
* A new parameter is added to MA-UNITDATA: a Radio Environment Request Vector to allow channel and transmission controls.
* A Radio Environment Report which indicates similar information is added to the MA-UNITDATA.indication.
* Also adding MLME-CANCELTX.request/.confirm
* Slide 7: An overview picture (not to be included in the Standard) which provides a high-level view of the layer component interactions.

C – Why is Radio Environment done via MA-UNITDATA, and not a management interface – is it meant to correspond to specific MSDUs, regardless of their order/timing of transmission? Is the .indication on the remote peer, or a local response that the settings have been applied?

C – The inclusion of frequency and primary channel in this list has an impact on how the STA can receive frames, also. How is that supposed to work?

R – I do not believe IEEE 1609 actually uses this interface that way.

C – Yes but putting this in the interface creates the ability for something else to use it, so it needs to be clear.

R – We could restrict the use of this to only ITS usage (or at least only OCB).

C – We may need to move the channel control items to a separate interface.

C – It is interesting to see the expiry time (in milliseconds) and number of repetitions in here. Those have interesting interactions with the stack.

C – A lot of these parameters are for control of the channel usage.

C – Is MSDU lifetime different than expiry time?

C – Isn’t that (MSDU lifetime) a MIB attribute, so applies to all MSDUs, not specific to each?

Questions or comments to convey back to TGbd:

* Why is Radio Environment done via MA-UNITDATA, and not a management interface? Is it intended to be “affiliated” with a particular MSDU, per MSDU?
* Is the MA-UNITDATA.indication meant to be on the peer device, providing the channel/radio information for a received MSDU? Or is this a ‘local’ response to the request to set the channel/radio information on the transmitter?
* How is the reception of frames expected to work, between the transmissions controlled by MA-UNITDATA.requests?
* It should be made clear that this new Radio Environment control is only for OCB operation.
* We probably need the channel control items (frequency band, primary channel, and maybe channel width) to be a separate interface.

**TGbe’s evolving multi-link architecture**

[**11-20/1122r3**](https://mentor.ieee.org/802.11/dcn/20/11-20-1122-03-00be-802-11be-architecture-association-discussion.pptx) **– 802.11be Architecture/Association Discussion – Joseph Levy**

Continuing discussion from Monday’s meeting. A quick recap:

* Overviewed 802.11’s current infrastructure architecture. Key concepts that 802.11be MLO could leverage, such as a single MAC SAP, and a MAC SAP-to-MAC SAP association (referring to this as an AP to non-AP concept – that is, an AP MLD is a new type of AP, it does not “contain” or “affiliate” multiple APs. The same logic applies to a non-AP MLD STAs which is STA and would not “contain” or “affiliate multiple STAs).
* Note this is not trying to reproduce 802.1AX and link aggregation above the MAC SAP level.
* Implied data plane architecture picture (slide 7, current -> slide 8, 11be).

C – What is the link aggregation work in 802.1?

A – 802.1AX.

C – Where is the security (802.1X) in the 802.1AX architecture?

R – Do not know. Would need to review and/or ask 802.1.

Pick back up at straw polls (slide 14), for any ARC comments, before these are presented to TGbe.

**SP1: The definition of a MLD AP should be changed in the draft spec and the SFD to clearly state that an MLD AP is an AP. (Having a single MAC SAP.) SP2: The definition of a non-AP MLD STA should be changed in the draft spec and the SFD to clearly state that a non-AP MLD STA is a STA. (Having a single MAC SAP.)**

C: Who assigns the MAC address to this single MAC SAP? Are there still MAC addresses “assigned” by the manufacturer to the individual PHY/lower MACs? A: Any real 11be AP is also going to be servicing “legacy” non-AP STAs. So, we have overlapping concepts operating at the same time on the same device. Those legacy appearances of the AP on the medium should have their own MAC addresses, to match legacy operation, and for link-specific operations like Beacons, group addressed frames, etc.

C: “MLD AP” should be “AP MLD”, per D0.1. (Fixed, on the fly.)

C: “MLD” is defined to be a device that has more than one affiliated STAs. Not sure why we are doing this change to a single AP that is MLD.

R: Agree this is a change. But the current SFD/draft say there is a single MAC SAP in an AP MLD, even though there are multiple APs. That is causing confusion and complicating the text language.

C: We need to support legacy devices with a “legacy AP” co-located with the APs doing MLO.

R: We should think about these as logical entities, and not get tied up in physical entities. The single AP or STA concept here can do multiple things.

C: Slide 8 shows one 802.1X authenticator.

R: This is a proposal, if an AP MLD is a single AP, then that makes sense and works. The security architecture in the alternate view is not clear. It needs to be discussed.

C: Seems the intention of these straw polls is to prevent a big mess of text in 11be that has “AP or AP MLD” type requirements throughout.

C: These really need to be 11be decisions.

R: Agreed, and these straw polls are for TGbe to decide. Just gathering input here.

C: If there is only “one AP”, then we still have to touch the spec in all the places that say (for example) an AP sends one series of Beacons, but the AP MLD sends multiple Beacons, has multiple other controls, too (power save mode, EDCA state, TWT, operating mode, etc.). Seems like this direction still means having to touch the spec in lots of places, so we have multiple power save states (per link), etc.

R: It is agreed that each PHY has some link-specific state. That can be handled in those entities and the “AP” only needs to know the overall state (for example, if all links are in power save, then buffer, else do not buffer – and call that the remote peer being in doze mode, or active mode, respectively, so no spec changes are needed at that level).

C: Still not convinced this is less text change.

C: Looking at slide 10, there is a lot of MLD-level functionality that is common across all the links. If we say an AP MLD is an AP, how do we talk about all the multiples of AP functionalities?

R: This stack is showing the peer-to-peer data plane frames. When we start adding the other functions, it is more complicated to discuss.

C: There are a lot of functions that are common to all the links. If each link is its own AP MLD, then how do we talk about the common functions?

R: The current description of an MLD having multiple APs has that problem, because an AP is defined (per my understanding) to be the whole stack up to the MAC SAP.

C: Do we say a “PHY interface of the AP is Beaconing” or “the AP is Beaconing”?

R: Each BSS has its Beacons, and there are still multiple BSSs, here.

C: Can see your point, but there are also implications of defining these (AP MLD) to be one AP entity (or one STA, in the general case). For example, what about radar detection? Think there are still a lot of place (like the radar detection item) that would need to be touched.

R: Yes, PHY management is still going to require text.

C: There are three different functions of an AP, and we need to not mix them up: 1) distribution function, 2) BSS management, and 3) management of the local device.

Moving on (to the next straw polls). The other concern is what we call a “link”, in the “multi-link” usage that is appearing in 11be.

**SP3: Rename “*multi-link*” to:**

1. ***“multi-PHY”* (MPHY)** yielding MPHYO, MPHY AP, non-AP MPHY STA
2. ***“multi-PHY-link”* (MPL)** yielding MPLO, MPL AP, non-AP MPL STA
3. **Do not change the name: “multi-link”** keeping MLO, MLD, MLD AP, non-AP MLD STA.

(note MP is already used in 802.11: MP: mesh protocol)

**SP4: Agree that the term “device” should not be used to describe a logical entity**

We will come back to this, after looking at 11-20/1639.

<switch to 11-20/1639 discussion>

[**11-20/1639r4**](https://mentor.ieee.org/802.11/dcn/20/11-20-1639-04-00be-11be-ap-mld-architecture-discussion.pptx)**: Continued discussion.**

Mark reviewed the document and introduced the “STA Database” as a function of existing APs and how they deal with STAs in different states and capabilities.

C – would this apply to non-VHT APs.

A – I see no reason to try to address it. How would we draw a legacy stack, is a challenge to those proposing add it into the figure.

## Next Steps:

**Next Teleconference(s):**

* Note: There has been a request for discussion of TGbc and TGbd. Teleconference plan for those discussions is pending contributions.
* Alternate Mondays (when TGbe does not meet), 19:00-21:00 ET.
	+ Next meeting on Nov 16 or Nov 23?

## Adjourned – 13:17 h EDT.

Note: final agenda slide deck is: [11-20/1696r4](https://mentor.ieee.org/802.11/dcn/20/11-20-1696-04-0arc-arc-sc-agenda-nov-2020.pptx)

**Attendance:**

Is captured in the 802.11 Plenary minutes.