IEEE P802.11
Wireless LANs

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| TGbn May June July 2024 Teleconference Minutes |
| Date: 2024-07-09 |
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Abstract

This document contains the minutes for TGbn May, June and July 2024 teleconferences.

Revision history:

* Rev0: First version of the document.

Abbreviations:

* C: Comment.
* A: Answer.

# 1st Conf. Call: May 30th, Thursday (10:00-12:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0967-00-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-in-may-to-july-2024.docx>
* PHY: (Cancelled)

# 2nd Conf. Call: June 3rd, Monday (19:00-21:00 ET) - Joint

* Call the meeting to order
* IEEE 802 and 802.11 IPR policy and procedure
	+ Patent Policy: Ways to inform IEEE:
	+ Cause an LOA to be submitted to the IEEE-SA (patcom@ieee.org); or
	+ Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible; or
	+ Speak up now and respond to this Call for Potentially Essential Patents

If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance, please respond at this time by providing relevant information to the WG Chair.

**Nobody speaked/writed up.**

* + Copyright Policy: Participants are advised that
	+ IEEE SA’s copyright policy is described in [Clause 7](https://standards.ieee.org/about/policies/bylaws/sect6-7.html#7) of the IEEE SA Standards Board Bylaws and [Clause 6.1](https://standards.ieee.org/about/policies/opman/sect6.html) of the IEEE SA Standards Board Operations Manual;
	+ Any material submitted during standards development, whether verbal, recorded, or in written form, is a Contribution and shall comply with the IEEE SA Copyright Policy.

**Copyright Policy was presented.**

* + **Patent, Participation, Copyright and policy related subclause:** Please refer to the agenda document([11-24-0964r2](https://mentor.ieee.org/802.11/dcn/24/11-24-0964-02-00bn-may-july-tgbn-teleconference-agenda.docx)).
* Attendance reminder.
	+ Participation slide: <https://mentor.ieee.org/802-ec/dcn/16/ec-16-0180-05-00EC-ieee-802-participation-slide.pptx>
	+ Please record your attendance during the conference call by using the IMAT system:
		- 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802 Wireless Interim/Plenary Session” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbn conference call that you are attending.
		- If you are unable to record the attendance via [IMAT](https://imat.ieee.org/attendance) then please send an e-mail to:
		Yusuke Asai (yusuke.asai@ntt.com) & Alfred Asterjadhi (aasterja@qti.qualcomm.com)
	+ Please ensure that the following information is listed correctly when joining the call:
	+ "[voter status] First Name Last Name (Affiliation)"
* Agenda
	+ Chair reviews proposed agenda found in [11-24-0964r2](https://mentor.ieee.org/802.11/dcn/24/11-24-0964-02-00bn-may-july-tgbn-teleconference-agenda.docx).
	+ Discussion:
		- [11-24/0530r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0530-00-00bn-indication-of-11bn-feature-set.pptx) was replaced with [11-24/0837r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0837-00-00bn-indication-of-use-case-in-11bn.pptx) by the request of the presentor.
		- [11-24/0478r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0478-00-00bn-ap-coordination-listening-instances.pptx) was deferred by the presentor.
	+ Modified agenda approved with unanimous consent.
* Technical Submissions – L4S + Misc. + MAP part 1:
	+ [11-24/0384r3](https://mentor.ieee.org/802.11/dcn/24/11-24-0384-03-00bn-low-latency-based-on-l4s.pptx): Low Latency Based on L4S Yan Li (ZTE)

C: I understand you got two class definition, some classifications of packets that support L4S and some signaling proposals for exchanging congestion. Both of those aspects are covered in the IP headers. Why do we need to add layer two signaling?

A: If the queueing delay is too big, the congestion is happened in the MAC layer.

C: Isn’t it easier for the MAC to apply the congestion notification at layer three, as opposed to having other signaling to the higher layers?

A: I gave two different options. The first one is we can just report it inside of the AP. MDSUs are still buffered in the AP’s MAC queue, which implementation can support to modify the IP layer. But, in this contribution, I have not modified this. I have to report such information to STAs. as the end point of the transmission. It can report it to the upper layer of the receiver. The receiver cannot report such information to the sender, and thus the standard can reduce its sending rate to mitigate.

C: The MAC is unable to change the IP header; therefore, you need to introduce all this stuff as a workaround.

A: Yes. It cannot modify such information inside of the AP.

C: To prevent the congestions in layer two, we need to do some actions in L2 as well. I mean that just giving a notification to upper layer does not solve the congestion problem.

A: We can do some actions to prevent the congestion in L2 but it is out of scope. In the baseline, we have some congestion control features for mesh STAs but the algorithm has not been defined and it is out of the scope. Besides, if the queueing delay is too big and it excess the threshold, we can define that this is congestion. For example, when current delay is 5 ms and the threshold is 3 ms, we think that the congestion occurs.

C: In your presentation, we talk about extending L4S to the MAC layer. When this notification of congestion occurs in the MAC layer, it is reported to the upper layer. I don’t see how the upper layers can prevent the congestion.

C: In the slide 9, you mentioned two options and you prefer the option 2. I also agree that is perhaps more straightforward. Wouldn’t the action frame for option 1 be a counterproductive? Do you need to associate that action frame to congestion first of all? In addition, will you add more traffic? I think it causes more contention.

A: Regarding the option 1, an action frame is not just the baseline knowing the congestion notification. It just reports that the AP has experienced such congestion. It cannot report the number of the congestion. You do not need to transmit too many packets. It is a general report.

C: Is it independent to the number of measured congestions?

A: Yes.

C: In your proposal 2 on the slide 11, are you attaching that congestion notification to the same packet, or are you advancing the congestion notification and reducing the latency?

A: I think their congestion notifications should be carried in the relevant MSDU, which has suffered congestion.

C: In the slide 7, you propose to enhance this classifier type of 4 for L4S traffic, right? For IPv6 and IPv4, right?

A: Yes.

C: There is already a DSCP field and it has one octet and ECN is a part of that one octet. Why do you propose to include a separate L4S field here? What is you thought on extending the octet to cover both DSCP and ECN?

A: I just want to point out that L4S is update is a new parameter, we should add it to the element. For how to add it, maybe we can still use the DSCP field.

C: If you are having like a flow today, you do this traffic classifier in the IP header and you could know that this is a L4S traffic.

A: In this contribution, I just want to focus on their use in their congestion notification. It seems like you have explained.

C: If the AP is already processing this IP flow, couldn’t the AP know this is an L4S traffic?

A: We can have more offline discussion.

C: I think that the essence of the L4S itself. I think L4S is for scalable throughput. How does this work if you have devices that in addition to having congestion or delay requirements also have throughout requirements?

A: This contribution is focus on the low delay. We have two different directions for the future, the first one is the QM and another one is the ECN. I think maybe ECM protocol more likely hooks on the delay.

C: Does this require all STAs to participate equally? I am wondering about the situations where you might have some STAs that have enhanced priority over others. Could they be exempt?

A: I think maybe it comes to the L4F feature itself, I just gave the extension to the same protocol.

C: We had a bunch of discussion on the queueing reporting and they were also like condition reporting and other thing like delay reporting. If you had a message flow and they could have this QoS measurement, the it also gives you the indication to the other side. If you are putting some information on the MSDU itself and the sending it out, it seems to overdesign for that kind of scenarios.

A: There are two different directions. It depends on implementation. It seems that it’s easy to report it to their IP layer inside.

C: In your summary slide, you classified two variations of L4S capable MSDUs. What is the relationship with L4S is capable and the mapping of TID architecture we have right now.

A: I think the L4S stream may have a higher QoS requirements compared with non-L4S traffic. If we can classify the L4S stream one way schedule, we can give it a high priority. This is a motivation of the classification for us.

C: If the MSDU map is embedded with the L4S flags, then there will be shared the same TID with other traffic.

A: Maybe we always map them to the same TID, but they have their different QoS characteristics. So, the schedule should guarantee the QoS requirements.

* + [11-24/0399r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0399-00-00bn-thoughts-on-l4s-in-wi-fi.pptx): Thoughts on L4S in Wi-Fi Binita Gupta (Cisco Systems)

C: In the slide 11, you have two sets of flows, both are marked for L4S and classic flows. One has in terms of the SCS and has more stringent cost parameter. How will these two flows be treated by the AP?

A: One SCS flow has more stringent cost parameters. But it is not an L4S flow, and then other flow is L4S and has less stringent cost parameters. The SCS scheduling would try to schedule the flow which has more stringent cost parameter to meet that flow. And at the same time, the AP would try to meet the cost parameters for L4S flow, but it is less stringent.

C: L4s is a kind of quasi-indication, but it is like a cost indication.

A: L4S itself is the way the low queuing delay by ECN marking because the senders have scalable throughput. When the data rate is reduced, the queue doesn’t build up. L4S would queue its own ECN marking whether we do it at L2 signaling and then the station does the ECN marking at layer three or indicating the congestion to the upper layer on the AP itself and then will do the marking of SCS packets. That will take care of keeping the latency or the queue shallow. Then, the station has indicated certain SCS parameters, the SCS scheduling will try to meet those SCS parameters for L4S flow. For example, if L4S flow has a 50 ms of delay bound and classic flow has 10 ms of delay bound, the classic flow would meet the 10 ms. Because in that case the STA scheduling is trying to keep the delay bound, and then it will try to meet the 50 ms of delay bound for L4S flow.

C: Do we currently have that behavior, right?

A: The L4S is extra bringing into the picture is essentially doing this congestion marking. We know where the congestion is not changed with this marking. The scheduling algorithm is all implementation specific. We don’t specific here how the scheduler will behave.

C: In the slide 4, dual queue philosophy is described. Here, you have a low latency queue, and you have a classic queue so low latency queue you can, it is a shallow L4S queue in wired networks. How can you keep one queue as a shallow queue? When this queue gets dequeue, it will largely depend on the congestion on the medium and also on channel contention process. If the medium is congested, will packets inside the low latency queue face longer delays, right?

A: If channel access is delayed, the queuing delay is longer even for L4S. If these packets started accumulating and then there is an opportunity to transmit on Wi-Fi, the packets are marked for congestion. But, if there is no channel access opportunity for some time, then we want to signal congestion in a packet which is up ahead in the transmit queue, so that the congestion can be transmitted.

C: How do you even keep that queue shallow? How do you ensure that can happen? In the example that you gave, you can see that queue also can get congested and essentially you would just have two queues. One would be a classic queue and the second would be a low latency queue and both of them would be equally congested. In wired networks, you could prevent this because it is a more of a scheduled based mechanism, but how do you ensure that in Wi-Fi?

A: When you have a transmit opportunity, you can prioritize sending flows from L4S queue. That would depend on the queuing logic.

C: What is the basically added value of any of those proposals versus the simply following the existing baseline and L4S rules for the access point? In the slide 6, there are two options and the option 1 does not provide the sufficient kind of tightness of the control the congestion. In addition, how much tight does the control have to be? And how would that picture change if the MLD is operated in multiple channels?

A: In this kind of proposal, it is hard to essentially have that tight control and then the throughput suffers when L4S queues are implemented at a higher layer. I think some level of simulation needs to be done how much better improvement we get in terms of better or optimal throughput with maintaining the lower latency.

C: The networking industry is exploring making significant invests in L4S. Though, we don’t think it is going to work effectively if it is blind to major delays such as L2 delays. In addition, of course, an 802.11 device is one of such sources of delays. But 802.11 cannot change layer 3 fields and MSDU. Does the 802.11 need a way to define for the MAC to the upper layers?

A: Definitely. I think that is assumption here, layer two MAC is not looking into IP. We propose to see what enhancement are needed to make L4S without making MAC layer looking deep into the layer three.

C: In the slide 9, I assume because this could be like end to end then one of the intermediate nodes has some layer 2 signaling to say that this MPDU is expecting congestion.

A: No. When L4S has experienced congestion, it marks in an MPDU, either the same MPDU or MPDUs which is ahead in the Tx queue, that there is layer two congestion experience. Because the congestion is experienced in the L4S queue at the MAC layer on the AP.

C: Could this MSDU or IP packet already have that congestion experienced marked based on previous nodes on the network?

A: It could, if it did that need to know up here because an AP is not looking into the IP header to check that.

C: I think delay information can be helpful.

* + [[11-24/0837r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0837-00-00bn-indication-of-use-case-in-11bn.pptx)](https://mentor.ieee.org/802.11/dcn/24/11-24-0375-00-00bn-nav-protection-for-c-tdma.pptx): Indication of Use Case in 11bn Akira Kishida (NTT)

C: Are you considering the use case per access point or per network type or the use case? Basically, the applications indicate a category of the use case and beyond such as voice or video. When you say use case, how do you map it to those scenarios? Is it the network dedicated to particular use case so that the STAs associated with that network? How does it help the 11bn use cases that we need to do some additional information? That is not clear to me.

A: Both network types and the use cases, like venue types, are defined in the interworking element. I would like to extend this information in more detail, for example, latency sensitive network or industry automation scenarios and so on.

C: (Chair) Do you want to run the SP?

A: Yes.

Straw Poll: Do you agree that indication the use case is beneficial in 11bn?

The straw poll was prepared but it was postponed due to the technical difficulties of WebEx.

* Any other business
	+ Discussion on deadline for uploading submission prior to meeting

C: In the F2F meetings, we have some time to travel to the meeting place and sometimes we arrive jet lagged. With regard to the limitations, it is not easy to review contributions especially when they are uploaded just before a F2F meeting. So, I friendly request if we can agree on a time frame for the submission s such that especially for a F2F meeting. For example, a week before a F2F meeting would be very good, but a few days also would be OK.

A(Chair): I would like to seek feedback from members as well. Right now, in 802.11, we do not have any requirements in terms of when document should be uploaded prior to the presentation. However, I announce the contributions should be uploaded at least 24 hours in advance prior to the scheduled conference call as a guideline. My feeling is that a week is a bit too much. But possibly we can target maybe 48 hours. Let’s put it there to the group to think about it.

C: Is it only for the initial contribution or revision as well?

A(Chair): I would expect for the initial contribution only.

C: The initial submission when the topic is new and we did not have any kind of discussion it before, right?

A(Chair): Yes.

C: We may agree on something. But we don’t want it to be too tight.

A(Chair): My expectation would be 48 hours prior to when the document is queued for presentation. In general, I have been stated that the document requested to be entertained for the F2F are essentially included or the requests are sent by 5 pm on Sunday, local time so that I use that information also to request any additional agenda time at CAC on 6 pm on Sunday. But, in terms of upload, I would expect 48 hours prior to that scheduled conference.

C: If we see the need for 48 hours, it makes sense.

A(Chair): I want to hear a little bit of the opinions.

C: For example, in the meeting week, if you have a discussion on Tuesday night, then can no longer post an update and have vote on it because it is too late. Any further negotiations during the meeting are worthless. I don’t think we need such a rule at all.

A(Chair): I don’t expect any of this discussion to go into any rules or requirements. I will still keep the flexibility within the bound of the progress for the group. If you have any further thoughts on this subject, please send an e-mail to me.

* Adjourned at 21:00.

# 3rd Conf. Call: June 6th, Thursday (10:00-12:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0967-01-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-in-may-to-july-2024.docx>
* PHY: <https://mentor.ieee.org/802.11/dcn/24/11-24-1079-00-00bn-minutes-802-11-tgbn-phy-ad-hoc-june-july.docx>

# 4th Conf. Call: June 13th, Thursday (10:00-12:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0967-01-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-in-may-to-july-2024.docx>
* PHY: (cancelled)

# 5th Conf. Call: June 17th, Monday (19:00-21:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0967-01-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-in-may-to-july-2024.docx>
* PHY: (cancelled)

# 6th Conf. Call: June 20th, Thursday (10:00-12:00 ET) - Joint

* Call the meeting to order
* IEEE 802 and 802.11 IPR policy and procedure
	+ Patent Policy: Ways to inform IEEE:
	+ Cause an LOA to be submitted to the IEEE-SA (patcom@ieee.org); or
	+ Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible; or
	+ Speak up now and respond to this Call for Potentially Essential Patents

If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance, please respond at this time by providing relevant information to the WG Chair.

**Nobody speaked/writed up.**

* + Copyright Policy: Participants are advised that
	+ IEEE SA’s copyright policy is described in [Clause 7](https://standards.ieee.org/about/policies/bylaws/sect6-7.html#7) of the IEEE SA Standards Board Bylaws and [Clause 6.1](https://standards.ieee.org/about/policies/opman/sect6.html) of the IEEE SA Standards Board Operations Manual;
	+ Any material submitted during standards development, whether verbal, recorded, or in written form, is a Contribution and shall comply with the IEEE SA Copyright Policy.

**Copyright Policy was presented.**

* + **Patent, Participation, Copyright and policy related subclause:** Please refer to the agenda document([11-24-0964r8](https://mentor.ieee.org/802.11/dcn/24/11-24-0964-08-00bn-may-july-tgbn-teleconference-agenda.docx)).
* Attendance reminder.
	+ Participation slide: <https://mentor.ieee.org/802-ec/dcn/16/ec-16-0180-05-00EC-ieee-802-participation-slide.pptx>
	+ Please record your attendance during the conference call by using the IMAT system:
		- 1) login to [imat](https://imat.ieee.org/attendance), 2) select “802 Wireless Interim/Plenary Session” entry, 3) select “C/LM/WG802.11 Attendance” entry, 4) click “TGbn conference call that you are attending.
		- If you are unable to record the attendance via [IMAT](https://imat.ieee.org/attendance) then please send an e-mail to:
		Yusuke Asai (yusuke.asai@ntt.com) & Alfred Asterjadhi (aasterja@qti.qualcomm.com)
	+ Please ensure that the following information is listed correctly when joining the call:
	+ "[voter status] First Name Last Name (Affiliation)"
* Agenda
	+ Chair reviews proposed agenda found in [11-24-0964r8](https://mentor.ieee.org/802.11/dcn/24/11-24-0964-08-00bn-may-july-tgbn-teleconference-agenda.docx).
	+ Discussion:
		- Some people announced revision number of the submissions.
	+ Modified agenda approved with unanimous consent.
* Technical Submissions – MAP Part 2:
	+ [11-24/0837r3](https://mentor.ieee.org/802.11/dcn/24/11-24-0384-03-00bn-low-latency-based-on-l4s.pptx): Indication of Use Case in 11bn [SP only] Akira Kishida (NTT)

C: I think it is not the reserved “bits” but “values.”

A: Agree with you.

Straw Poll:

Do you agree to extend the Access Network Options field in 11bn?

* + - Note: this intends to use reserved values (6-13) in the Access Network Type in the Access Network Options field to indicate the UHR use cases (TBD).

The record on WebEx application: Y:19%, N:17%, Abs:65% (Total number of votes: 113)

(Note: The exact number of WebEx votes for yes/no/abstain could not be identified.)

The additional vote on chat window: Y:1, N:2, Abs:3

The estimated total result: Y:22, N:21, Abs:76

* + [11-24/0719r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0719-00-00bn-map-set-operation.pptx): MAP Set operation Jay Yang (ZTE)

C: That’s a good observation for multiple BSSID. Is that doable if only the transmitter BSS ID is responsible for the muti-AP coordination, and the non-transmitted BSSID, those BSSs can simply use the shared TXOP?

A: This is one case you said about multi-AP BSSID feature. We also need to consider the co-hosted multiple BSSID. So, we want to put them together if we support both, how to address this one co-hosted BSSID sets its coordination.

C: In the slide 4, your motivation is that APs are in a multi BSSID set or co-hosted set, you can add or delete APs at any time. It is not a frequent occurrence. In 11be, the ML reconfiguration is not happened very often. In that sense, these APs that are getting added or removed, it is like a once in a while. In many cases, it may not even happen throughout the lifetime of OBSS. Whenever it happens, it is like an update, unique renegotiation, which can happen even in a non-multi OBSS case. What are your thoughts on that?

A: I think you are probably right. It is not very frequently to add or delete APs, but it depends on use cases. So maybe in some case, it's not up to date, maybe and allocates it's totally different, but we can have a different use case to meet different requirements.

C: OK. In the slide 7, the AP1 gains access to the medium and it is the TXOP owner, and now it shares TXOP with some other AP. It is based on a MAC address, I assume. But in fact, the TXR is getting used by somebody different, right? Isn’t that going to lead to some other issues?

A: I will discuss on the reflector.

C: In the slide 4, can you explain what is the basic problem of the overhead issue? This is true that all the APs use the same channel, same antenna and receiver antenna, but they are not using them at the same time. So, why do you have to have m by n?

A: As you said, if mutli-APs are TDMA manner, first we need to set up agreement as two APs. For example, if there are more than two APs want to do some coordination, there need multi-AP agreement.

C: I mean you can do an agreement with one of the APs in set one with one or more of the AP or set two, but it is not M times an agreement. I don’t understand this.

A: This radio schedule the all the APs in the second radio, if that is some time overlap, for example, if the first time slot AP21 overlap with the AP11, they may set up multi-AP coordination scheme.

C: I do not understand why this is the problem and why this problem is in multi BSSID set. I think it is not the problem even in multi BSSID set.

C: It seems that the upper bound of the number of coordinations is more than those actually happen. I think these kinds of coordination messages happen once in a while, and maybe not all the combination or exercise all the time. The problem may be more or less pronounced depending on the occurrence. I am not sure of the occurrence. Is this only applied to the collocated APs, or is there any plan to extend to non-collocated APs?

A: For now, I consider co-located APs only.

* + [11-24/0639r1](https://mentor.ieee.org/802.11/dcn/24/11-24-0639-01-00bn-mac-protocol-aspects-of-multi-ap-coordination.pptx): MAC protocol aspects of multi-AP coordination

 Sindhu Verma (Broadcom)

C: You are not saying that this is not just about MU-MIMO beam forming. Could this be any kind of coordination in terms of OFDMA or even some kind of SU BF those all supported by this approach?

A: We are talking about CBF, which is one multi-AP coordination scheme. But these four steps would be parts of any kind of multi-AP coordination.

C: In the slide 8, if the AP1-STA and AP2-STA are closed by, it is not possible that the AP2-STA would hear the CTS from the AP1 -STA, and then the medium is busy. So, they do not respond with the CTS and the blue CTS would block out the green CTS, right?

A: Yes. That is why there has to be some special understanding for any UHR multi-AP coordination scheme where this AP1 sends this initial control frame. There would be special field in the initial frame to indicate that this is an initiation of a coordinated TXOP where all participating or candidates of non-AP STAs will perceive it likewise.

C: Would it be in the green frame? Because the green AP2-STAs might not hear the blue MU-RTS /CTS frames.

A: Yes.

C: In the slide 6, you said the sounding very briefly. Do you mean the regular sounding as we have it or you plant to do any changes with the sounding sequence and so far?

A: We didn’t go into the details of the sounding process. But there is no sounding feedback that is conventionally acquired for another AP from one AP’s client. So, there has to be some enhancements in sounding where a non-AP can feedback its CSI from the partner CBF AP.

C: How do you collect all these CSI?

A: One example is NDPA is provided only by the serving AP, whereas the NDP is composed of pilots from both the APs and the feedback from the non-AP corresponds to what is received from both of the APs. Another example is each time there is a NDPA but either this AP or the other AP provides the NDP. So, the sounding feedback that is provided is one at a time. There are multiple options and we have not gone into detail, but we have thought about the possible options in the next version.

C: Which sounding did you use in your simulation result?

A: This simulation is strictly doing in the MAC aspects of the MAP TXOP coronation, which are the primary sources of overhead. We have had another contribution in joint session, where we show performance of CBF and CSR with sounding overhead.

C: In the slide 8, CSI is very important in the CBF So, I think we have to define if it is implicit feedback or explicit feedback, or real CSI is shared or not. I think this is a crucial point. If you have anything add to your answer to the previous question, please go ahead.

A: We should look at it as just DL MU-MIMO only that the sources are co-located. So, sounding overhead and processes also similar, it is just that we need some coordination for the non-AP to provide feedback.

C: I agree with CBF would be beneficial for throughput improvement, but the requirement of synchronization should be concerned. In the slide 8, the AP1 and the AP2 transmits the MU-RTS just after SIFS. I would like to ask how to synchronize between the AP1 and the AP2. I am wondering some trigger frames can be used for synchronization.

A: The initial frame transmitted by the AP1 is also received by the AP2. They are able to do CBF because they are within a hearing range of each other. So, this special initial control frame that marks the start of a CBF TXOP is also heard by the AP2 and it serves to synchronize the two of them.

C: If non-AP STAs are EMLSR STAs, which require the ICF/ ICR before transmitting a packet, we can reduce the signaling overhead just by changing ICF/ICR between the sharing AP and the STAs.

A: One advantage of our proposal is it would cover EMSLR. There are so many other use cases also where initial control frame serves to initiate some kind of switch and the non-APs can provide response.

C: In the slide 8, I am also concerned about the actual sounding procedures. Where is the sounding protocol, at the yellow CBF PPDU?

A: Sounding does not happen every TXOP, because that will be intensive overhead. So, those steps in the slide 8 just show the coordination that happens in every TXOP. The sounding information doesn’t change often.

C: In CBF, I would like to make sure that non-AP STAs need to feedback the CSI not only the for the affiliated AP but also for those OBSS APs as well. Is it correct?

A: Yes, correct. The sounding step does not occur per TXOP.

C: In the slide 7, not only the sharing AP but also the shared AP indicate the set of STAs. It intends to use spatial streams. One concern regarding this is that the sharing AP already decided how may streams it want to send. If it made changes based on what the shared AP provides, this could lead to happen like ping-pong negotiations. Are you envisioning CBF where the shared AP opportunistically access the channel while doing the analysis or even the sharing AP is making the changes?

A: The intent is to provide some flexibility to both APs. If the sharing AP does not indicate a choice of clients to the shared AP and just goes ahead with a small set of clients that it has identified, then the shared AP may not always be able to find clients with traffic that correspond to it. So, at the beginning, the sharing AP tells the shared AP for the possible clients sets that it can transmit to shared AP tell set about the clients that have traffic with it.

C: In the slide 13, for example, in 30 dB SNR column, as you explain the empty block, if interference were below noise level or insignificant, then you would have the same performance in both coordination and no coordination cases. I am surprised that as interference is decreasing, it looks like CBF gain is increasing at lower the interference more the gain of coordination. What is the explanation for that?

A: These APs are within here any range of each other. When they are within hearing range of each other, they do normal CCA and they are not going to transmit at the same time. So, you have to have some coordination scheme in that case, maybe either reduce the threshold or perform some coordinated spatial reuse, for example. That is why CBF gains are continuing to increase because these APs are still taking turns to transmit even though the interference is low.

C: In the slide13, focusing on the first row, the gain is increasing when the SNR decreases, but only the last column, we see slight decrease. So, I just wonder if this is some randomness in a simulation or you see this consistency. Why does you know the gains of a little bit?

A: These gains of each SNR correspond to a certain MCS without CBF. There can be some nonlinearities deeding upon what MCS is chosen.

C: If you are doing CBF with sounding, you need a lot of MU-MIMO transmission. This makes you very sensitive to the traffic pattern. And you assume full buffer traffic in your simulation, but in a lot of scenarios, we do not see anything close to full buffer. Do you have plans to do simulation to consider that?

A: Full-buffet traffic performance also corresponds to performance when you have a high congestion and high data rate, etc. And for example, if you have just two APs and two clients, and we assume finite traffic, there are some sensitivities to IP scheduling. It depends on the scheduling what length of the PPDU to choose, how to utilize the TXOP, the finite traffic in the presence of congestion, and so on.

* + [11-24/0716r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0716-00-00bn-buffer-status-report-in-multi-ap-follow-up.pptx): Buffer Status Report in Multi-AP – Follow Up Pei Zhou (TCL)

C: In the side 11, I agree with your direction. For low latency traffic, probably the priority you point out is more important. From that aspect, I would like to raise that the middle point between requesting resources and exact buffer is a candidate as well.

C: In the slide 11, you only talk about queue size format for computing the BSR. But I think it needs to consider TXOP of airtime that the shared AP need for its BSS. Because the MCS and so on are just the decided by the sharing AP and maybe it can be changed. So, it is better to consider the duration of time that the shared AP can invoke. What do you think about this?

A: I think MCS can be used as a reference tool for the shared AP to estimate the upper bound and the lower bound of the resource allocation. Maybe this resource allocation is not as so accurate, but we have TXOP return method. I think the use of the queue size is easily and we can use other attributes as references.

C: I think the duration and the bandwidth are simple mean.

A: The time duration has some drawback as described in the question one.

C: Do you assume the different APs from the same vendor, or from the different vendors? If they are the same vendor, there might be no need to standardize the procedure that you propose to your presentation.

A: The AP has the knowledge of the downlink buffer for its associated STAs, and the AP can also collect uplink buffer from its associated STAs. So, the AP has knowledge of both uplink and downlink buffer size. By using this information, it is up to the AP to contain management frames of QoS to the nearby APs. So, I think there is no issue to hear the BSR.

C: I'm not sure why you say that resource allocation is far easier than airtime, because airtime will probably be simpler, and also give the flexibility to the AP to use the time in whichever way it was because it was the guy who knew also that we have to be here speaking with patients with multiple stations to prioritize.

C: If the update of MCS/NSS is needed per STA, that could lead to a lot of updates for the sharing AP to estimate it accurately. I think more fore thoughts is needed there.

C: Providing airtime information might be sufficient and let the AP decide. In addition, when is the solicitation done? Is it within the TXOP?

A: I think it can be before the shared duration.

C: But you need to be careful because the APs’ traffic needs could change. There is a lot of dynamics. So, it is before sharing the TXOP you need to know who is the neediest AP. I think it is beneficial to poll right at the TXOP before deciding whom to share with you can’t rely on past information.

A: We have the similar mechanisms in 11be the TXOP sharing before the trigger TXOP sharing. We can collect as a BSR but is not mandatory.

* Adjourned at 12:00.

# 7th Conf. Call: June 24th, Monday (19:00-21:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0967-02-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-in-may-to-july-2024.docx>
* PHY: (cancelled)

# 8th Conf. Call: June 27th, Monday (10:00-12:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: (to be available)
* PHY: (cancelled)

**Appendix**

* Attendee List for the 2nd Conf. Call:

|  |  |  |  |
| --- | --- | --- | --- |
| Breakout | Timestamp | Name | Affiliation |
| TGbn | 6/3 | Abouelseoud, Mohamed | Apple Inc. |
| TGbn | 6/3 | Aio, Kosuke | Sony Corporation |
| TGbn | 6/3 | Ajami, Abdel Karim | Apple Inc. |
| TGbn | 6/3 | Anwyl, Gary | Mediatek Inc |
| TGbn | 6/3 | Asai, Yusuke | Nippon Telegraph and Telephone Corporation (NTT) |
| TGbn | 6/3 | Asterjadhi, Alfred | Qualcomm Incorporated |
| TGbn | 6/3 | Au, Kwok Shum | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Baek, SunHee | LG ELECTRONICS |
| TGbn | 6/3 | Batra, Anuj | Apple Inc. |
| TGbn | 6/3 | Baykas, Tuncer | Ofinno |
| TGbn | 6/3 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbn | 6/3 | Canpolat, Necati | Intel |
| TGbn | 6/3 | Carney, William | Sony Group Corporation |
| TGbn | 6/3 | Cha, Dongju | LG ELECTRONICS |
| TGbn | 6/3 | Chen, You-Wei | MediaTek Inc. |
| TGbn | 6/3 | CHENG, yajun | Xiaomi Communications Co., Ltd. |
| TGbn | 6/3 | Chisci, Giovanni | Qualcomm Technologies, Inc |
| TGbn | 6/3 | Cho, Hangyu | LG ELECTRONICS |
| TGbn | 6/3 | Choi, JinHo | SAMSUNG ELECTRONICS |
| TGbn | 6/3 | Choi, Jinsoo | LG ELECTRONICS |
| TGbn | 6/3 | Chu, Liwen | NXP Semiconductors |
| TGbn | 6/3 | Derham, Thomas | Broadcom Corporation |
| TGbn | 6/3 | Dong, Xiandong | Xiaomi Communications Co., Ltd. |
| TGbn | 6/3 | Ekkundi, Manasi | SAMSUNG ELECTRONICS |
| TGbn | 6/3 | Erkucuk, Serhat | Ofinno |
| TGbn | 6/3 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbn | 6/3 | Fang, Yonggang | MediaTek Inc. |
| TGbn | 6/3 | Ganji, Mehdi | Charter Communications |
| TGbn | 6/3 | Gao, Ning | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbn | 6/3 | Gu, Jaheon | Samsung Electronics Co., Ltd. |
| TGbn | 6/3 | Gu, Junrong | Clourney Semiconductor |
| TGbn | 6/3 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbn | 6/3 | Gupta, Binita | Cisco Systems, Inc. |
| TGbn | 6/3 | Ha, Taeyoung | Samsung Electronics Co., Ltd. |
| TGbn | 6/3 | Haider, Muhammad Kumail | Meta Platforms, Inc. |
| TGbn | 6/3 | Hasabelnaby, Mahmoud | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Hedayat, Ahmadreza | Apple Inc. |
| TGbn | 6/3 | Helwa, Sherief | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 6/3 | Henry, Jerome | Cisco Systems, Inc. |
| TGbn | 6/3 | Hervieu, Lili | CableLabs |
| TGbn | 6/3 | Ho, Duncan | Qualcomm Technologies, Inc |
| TGbn | 6/3 | Hosseinianfar, Hamid | Ofinno |
| TGbn | 6/3 | Hsu, Yung Lin | National Taiwan University |
| TGbn | 6/3 | Hu, Chunyu | Spreadtrum Communications US |
| TGbn | 6/3 | HUANG, CHIHAN | MediaTek Inc. |
| TGbn | 6/3 | Huang, Po-Kai | Intel Corporation |
| TGbn | 6/3 | Inohiza, Hirohiko | Canon |
| TGbn | 6/3 | Inoue, Kyosuke | SHARP CORPORATION |
| TGbn | 6/3 | Kabbinale, Aniruddh | Samsung Electronics Co., Ltd. |
| TGbn | 6/3 | Kalamkar, Sanket | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 6/3 | Kamel, Mahmoud | Interdigital Inc. |
| TGbn | 6/3 | Kandala, Srinivas | Samsung |
| TGbn | 6/3 | Kim, Geon Hwan | LG ELECTRONICS |
| TGbn | 6/3 | Kim, Jeongki | Ofinno |
| TGbn | 6/3 | Kim, Jungjun | Samsung Electronics Co., Ltd. |
| TGbn | 6/3 | Kim, Sang Gook | LG ELECTRONICS |
| TGbn | 6/3 | Kim, Suhwook | SAMSUNG ELECTRONICS |
| TGbn | 6/3 | Kim, Youhan | Qualcomm Technologies, Inc. |
| TGbn | 6/3 | Kishida, Akira | NTT |
| TGbn | 6/3 | Klein, Arik | Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Kuo, Chih-Chun | MediaTek Inc. |
| TGbn | 6/3 | Lanante, Leonardo | Ofinno |
| TGbn | 6/3 | Lee, Hong Won | LG ELECTRONICS |
| TGbn | 6/3 | LEE, JOONSOO | Newracom Inc. |
| TGbn | 6/3 | LEE, Mingyu | Samsung Electronics Co., Ltd. |
| TGbn | 6/3 | Levy, Joseph | InterDigital, Inc. |
| TGbn | 6/3 | Li, Jialing | Qualcomm Technologies, Inc |
| TGbn | 6/3 | Li, Weiyi | Spreadtrum Communication USA, Inc |
| TGbn | 6/3 | Li, Yapu | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbn | 6/3 | Lim, Yeon Geun | Newracom Inc. |
| TGbn | 6/3 | Lou, Hanqing | InterDigital, Inc. |
| TGbn | 6/3 | Lu, Liuming | Guangdong OPPO Mobile Telecommunications Corp.,Ltd. |
| TGbn | 6/3 | LU, Yuxin | TCL Industries |
| TGbn | 6/3 | Ma, Yongsen | SAMSUNG ELECTRONICS |
| TGbn | 6/3 | Minotani, Jun | Panasonic Holdings Corporation |
| TGbn | 6/3 | Mohamed Hassan Salem, Nedime Pelin | Cisco Systems, Inc. |
| TGbn | 6/3 | Monajemi, Pooya | Apple Inc. |
| TGbn | 6/3 | Motozuka, Hiroyuki | Panasonic Holdings Corporation |
| TGbn | 6/3 | Mutgan, Okan | Nokia |
| TGbn | 6/3 | Namvar, Nima | Charter Communications |
| TGbn | 6/3 | Nayak, Peshal | Samsung Research America |
| TGbn | 6/3 | Neishaboori, Azin | General Motors Company |
| TGbn | 6/3 | Nogami, Toshizo | SHARP CORPORATION |
| TGbn | 6/3 | Noh, Si-Chan | Newracom Inc. |
| TGbn | 6/3 | Norouzi, Sara | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Ouchi, Masatomo | Canon |
| TGbn | 6/3 | Park, Sungjin | Senscomm |
| TGbn | 6/3 | Patil, Abhishek | Qualcomm Incorporated |
| TGbn | 6/3 | Patwardhan, Gaurav | Hewlett Packard Enterprise |
| TGbn | 6/3 | Petrick, Albert | InterDigital, Inc. |
| TGbn | 6/3 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbn | 6/3 | Ratnam, Vishnu | Samsung Research America |
| TGbn | 6/3 | Ryu, Kiseon | NXP Semiconductors |
| TGbn | 6/3 | Sakamoto, Ryunosuke | SHARP CORPORATION |
| TGbn | 6/3 | Sato, Takuhiro | SHARP CORPORATION |
| TGbn | 6/3 | Schelstraete, Sigurd | MaxLinear |
| TGbn | 6/3 | Shafin, Rubayet | Samsung Research America |
| TGbn | 6/3 | Shi, Zhenpeng | Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Shirakawa, Atsushi | SHARP CORPORATION |
| TGbn | 6/3 | SUH, JUNG HOON | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Sun, Bo | Sanechips Technology Co., Ltd. |
| TGbn | 6/3 | Tanaka, Yusuke | Sony Corporation |
| TGbn | 6/3 | Taori, Rakesh | Infineon Technologies |
| TGbn | 6/3 | Tseng, Yen Hsiung | MediaTek Inc. |
| TGbn | 6/3 | Urabe, Yoshio | Panasonic Holdings Corporation |
| TGbn | 6/3 | Wang, Lei | Futurewei Technologies/Huawei Technologies |
| TGbn | 6/3 | Wang, Ying | InterDigital, Inc. |
| TGbn | 6/3 | Wee, Gaius | Panasonic Holdings Corporation |
| TGbn | 6/3 | Wei, Dong | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbn | 6/3 | Wu, Kanke | Apple Inc. |
| TGbn | 6/3 | Wullert, John | Peraton Labs |
| TGbn | 6/3 | Xia, Qing | Sony Corporation |
| TGbn | 6/3 | Xiao, Tong | Xiaomi Communications Co., Ltd. |
| TGbn | 6/3 | Xu, Yanchao | Amlogic |
| TGbn | 6/3 | Xu, Yue | Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Yamada, Ryota | SHARP CORPORATION |
| TGbn | 6/3 | Yang, Jay | ZTE Corporation |
| TGbn | 6/3 | YANG, RUI | InterDigital, Inc. |
| TGbn | 6/3 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 6/3 | Yee, James | MediaTek Inc. |
| TGbn | 6/3 | Yukawa, Mitsuyoshi | Canon |
| TGbn | 6/3 | Zhang, Yan | Apple Inc. |
| TGbn | 6/3 | Zhao, Yue | Huawei Technologies Co., Ltd |
| TGbn | 6/3 | Zhou, Lei | H3C Technologies Co., Limited |
| TGbn | 6/3 | Zhou, Pei | TCL |
| TGbn | 6/3 | Zuniga, Juan Carlos | Cisco Systems, Inc. |

* Attendee List for the 6th Conf. Call:

|  |  |  |  |
| --- | --- | --- | --- |
| Breakout | Timestamp | Name | Affiliation |
| TGbn | 6/20 | Abouelseoud, Mohamed | Apple Inc. |
| TGbn | 6/20 | Adhikari, Shubhodeep | Broadcom Corporation |
| TGbn | 6/20 | Aio, Kosuke | Sony Corporation |
| TGbn | 6/20 | Ajami, Abdel Karim | Apple Inc. |
| TGbn | 6/20 | Asai, Yusuke | Nippon Telegraph and Telephone Corporation (NTT) |
| TGbn | 6/20 | Baykas, Tuncer | Ofinno |
| TGbn | 6/20 | Bredewoud, Albert | Broadcom Corporation |
| TGbn | 6/20 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Canpolat, Necati | Intel |
| TGbn | 6/20 | Carney, William | Sony Group Corporation |
| TGbn | 6/20 | Cha, Dongju | LG ELECTRONICS |
| TGbn | 6/20 | Chaturvedi, Abhishek | Samsung Electronics |
| TGbn | 6/20 | CHENG, yajun | Xiaomi Communications Co., Ltd. |
| TGbn | 6/20 | Chisci, Giovanni | Qualcomm Technologies, Inc |
| TGbn | 6/20 | Choi, JinHo | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Choo, Seungho | Senscomm Semiconductor Co., LTD |
| TGbn | 6/20 | Chu, Liwen | NXP Semiconductors |
| TGbn | 6/20 | Chung, Chulho | SAMSUNG |
| TGbn | 6/20 | Dong, Xiandong | Xiaomi Communications Co., Ltd. |
| TGbn | 6/20 | Ekkundi, Manasi | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Erkucuk, Serhat | Ofinno |
| TGbn | 6/20 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbn | 6/20 | Fang, Juan | Intel Corporation |
| TGbn | 6/20 | Fang, Yonggang | MediaTek Inc. |
| TGbn | 6/20 | feng, Shuling | MediaTek Inc. |
| TGbn | 6/20 | Fischer, Matthew | Broadcom Corporation |
| TGbn | 6/20 | Fujimori, Yuki | Canon Research Centre France |
| TGbn | 6/20 | Gao, Ning | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbn | 6/20 | Ghosh, Chittabrata | Apple Inc. |
| TGbn | 6/20 | Gu, Jaheon | Samsung Electronics Co., Ltd. |
| TGbn | 6/20 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbn | 6/20 | GUIGNARD, Romain | Canon Research Centre France |
| TGbn | 6/20 | Gupta, Binita | Cisco Systems, Inc. |
| TGbn | 6/20 | Ha, Taeyoung | Samsung Electronics Co., Ltd. |
| TGbn | 6/20 | Hasabelnaby, Mahmoud | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Hedayat, Ahmadreza | Apple Inc. |
| TGbn | 6/20 | Helwa, Sherief | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 6/20 | Ho, Duncan | Qualcomm Technologies, Inc |
| TGbn | 6/20 | Hosseinianfar, Hamid | Ofinno |
| TGbn | 6/20 | Hsu, Yung Lin | National Taiwan University |
| TGbn | 6/20 | HUANG, CHIHAN | MediaTek Inc. |
| TGbn | 6/20 | huang, kaikai | Nokia |
| TGbn | 6/20 | Huang, Po-Kai | Intel Corporation |
| TGbn | 6/20 | Jang, Insun | LG ELECTRONICS |
| TGbn | 6/20 | Jee, Anand | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Kabbinale, Aniruddh | Samsung Electronics Co., Ltd. |
| TGbn | 6/20 | Kain, Carl | Noblis, Inc.; USDoT |
| TGbn | 6/20 | Kakani, Naveen | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 6/20 | Kalamkar, Sanket | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 6/20 | Kamel, Mahmoud | Interdigital Inc. |
| TGbn | 6/20 | Kandala, Srinivas | Samsung |
| TGbn | 6/20 | Karthik, S. G. | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Kedem, Oren | Maxlinear |
| TGbn | 6/20 | Kim, Geon Hwan | LG ELECTRONICS |
| TGbn | 6/20 | Kim, Jeongki | Ofinno |
| TGbn | 6/20 | Kim, Jungjun | Samsung Electronics Co., Ltd. |
| TGbn | 6/20 | Kim, Sang Gook | LG ELECTRONICS |
| TGbn | 6/20 | Kim, Sanghyun | WILUS Inc. |
| TGbn | 6/20 | Kim, Suhwook | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Kishida, Akira | NTT |
| TGbn | 6/20 | Klein, Arik | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Koo, Jonghoe | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Lanante, Leonardo | Ofinno |
| TGbn | 6/20 | Lee, Hong Won | LG ELECTRONICS |
| TGbn | 6/20 | LEE, JOONSOO | Newracom Inc. |
| TGbn | 6/20 | LEE, Mingyu | Samsung Electronics Co., Ltd. |
| TGbn | 6/20 | Levy, Joseph | InterDigital, Inc. |
| TGbn | 6/20 | Li, Jialing | Qualcomm Technologies, Inc |
| TGbn | 6/20 | Li, Weiyi | Spreadtrum Communication USA, Inc |
| TGbn | 6/20 | li, yan | ZTE Corporation |
| TGbn | 6/20 | Li, Yapu | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbn | 6/20 | Lim, Dong Guk | LG ELECTRONICS |
| TGbn | 6/20 | Lim, Yeon Geun | Newracom Inc. |
| TGbn | 6/20 | Liu, Zhe | sanechips |
| TGbn | 6/20 | Lorgeoux, Mikael | Canon Research Centre France |
| TGbn | 6/20 | Lu, Liuming | Guangdong OPPO Mobile Telecommunications Corp.,Ltd. |
| TGbn | 6/20 | LU, Yuxin | TCL Industries |
| TGbn | 6/20 | Luo, Chaoming | Beijing OPPO telecommunications corp., ltd. |
| TGbn | 6/20 | Ma, Yongsen | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | McCann, Stephen | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Minotani, Jun | Panasonic Holdings Corporation |
| TGbn | 6/20 | Montemurro, Michael | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Mutgan, Okan | Nokia |
| TGbn | 6/20 | Namvar, Nima | Charter Communications |
| TGbn | 6/20 | Nayak, Peshal | Samsung Research America |
| TGbn | 6/20 | Neishaboori, Azin | General Motors Company |
| TGbn | 6/20 | Nezou, Patrice | Canon Research Centre France |
| TGbn | 6/20 | Nogami, Toshizo | SHARP CORPORATION |
| TGbn | 6/20 | Noh, Si-Chan | Newracom Inc. |
| TGbn | 6/20 | Norouzi, Sara | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Nurani Krishnan, Neelakantan | Apple Inc. |
| TGbn | 6/20 | Park, Sungjin | Senscomm |
| TGbn | 6/20 | Patil, Abhishek | Qualcomm Incorporated |
| TGbn | 6/20 | Qi, Yue | Samsung Research America |
| TGbn | 6/20 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbn | 6/20 | Ratnam, Vishnu | Samsung Research America |
| TGbn | 6/20 | RISON, Mark | Samsung Cambridge Solution Centre |
| TGbn | 6/20 | Roy, Rishabh | SAMSUNG ELECTRONICS |
| TGbn | 6/20 | Ryu, Kiseon | NXP Semiconductors |
| TGbn | 6/20 | Sadiq, Bilal | Samsung Research America |
| TGbn | 6/20 | Sato, Takuhiro | SHARP CORPORATION |
| TGbn | 6/20 | Schelstraete, Sigurd | MaxLinear |
| TGbn | 6/20 | Shafin, Rubayet | Samsung Research America |
| TGbn | 6/20 | Shi, Zhenpeng | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Shilo, Shimi | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Singh, Aditi | Charter Communications |
| TGbn | 6/20 | SUH, JUNG HOON | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Talarico, Salvatore | Sony Corporation |
| TGbn | 6/20 | Tanaka, Yusuke | Sony Corporation |
| TGbn | 6/20 | Tota, Kazuyuki | Canon |
| TGbn | 6/20 | Tseng, Yen Hsiung | MediaTek Inc. |
| TGbn | 6/20 | Tsodik, Genadiy | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Val, Inaki | MaxLinear, Inc. |
| TGbn | 6/20 | Varshney, Prabodh | Nokia |
| TGbn | 6/20 | Verma, Sindhu | Broadcom |
| TGbn | 6/20 | Wang, Hao | Tencent |
| TGbn | 6/20 | Wang, Lei | Futurewei Technologies/Huawei Technologies |
| TGbn | 6/20 | Wang, Qi | Apple Inc. |
| TGbn | 6/20 | Wang, Ying | InterDigital, Inc. |
| TGbn | 6/20 | Wee, Gaius | Panasonic Holdings Corporation |
| TGbn | 6/20 | Wei, Dong | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbn | 6/20 | Wu, Kanke | Apple Inc. |
| TGbn | 6/20 | Wu, Tianyu | Apple Inc. |
| TGbn | 6/20 | Wullert, John | Peraton Labs |
| TGbn | 6/20 | Xia, Qing | Sony Corporation |
| TGbn | 6/20 | Xiao, Tong | Xiaomi Communications Co., Ltd. |
| TGbn | 6/20 | Xu, Fangxin | Longsailing Semiconductor |
| TGbn | 6/20 | Xu, Yanchao | Amlogic |
| TGbn | 6/20 | Xu, Yue | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Yan, Zhongjiang | Northwestern Polytechnical University |
| TGbn | 6/20 | Yang, Haorui | China Mobile |
| TGbn | 6/20 | Yang, Jay | ZTE Corporation |
| TGbn | 6/20 | Yang, Jimmy | Moxa Inc. |
| TGbn | 6/20 | YANG, RUI | InterDigital, Inc. |
| TGbn | 6/20 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 6/20 | Yee, James | MediaTek Inc. |
| TGbn | 6/20 | Yoon, Yelin | LG ELECTRONICS |
| TGbn | 6/20 | Yu, Jian | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Zhang, Jiayi | Ofinno |
| TGbn | 6/20 | Zhang, Maolin | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Zhao, Yue | Huawei Technologies Co., Ltd |
| TGbn | 6/20 | Zhong, Ke | Ruijie Networks Co.,Ltd. |