IEEE P802.11
Wireless LANs

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| TGbn March April May 2024 Teleconference Minutes |
| Date: 2024-05-02 |
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Abstract

This document contains the minutes for TGbn March, April and May 2024 teleconferences.

Revision history:

* Rev0: First version of the document.
* Rev1: Add the minutes for the 5th through 7th teleconferences and fixed typos.

Abbreviations:

* C: Comment.
* A: Answer.

# 1st Conf. Call: March 28th, Thursday (10:00-12:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0638-01-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-from-march-to-may-2024.docx>
* PHY: <https://mentor.ieee.org/802.11/dcn/24/11-24-0641-00-00bn-minutes-tgbn-phy-ad-hoc-march-to-april-cc.docx>

# 2nd Conf. Call: April 8th, Monday (19:00-21:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0638-02-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-from-march-to-may-2024.docx>
* PHY: <https://mentor.ieee.org/802.11/dcn/24/11-24-0641-01-00bn-minutes-tgbn-phy-ad-hoc-march-to-april-cc.docx>

# 3rd Conf. Call: April 11th, Thursday (10:00-12:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: <https://mentor.ieee.org/802.11/dcn/24/11-24-0638-02-00bn-minutes-for-tgbn-mac-ad-hoc-teleconferences-from-march-to-may-2024.docx>
* PHY: <https://mentor.ieee.org/802.11/dcn/24/11-24-0641-01-00bn-minutes-tgbn-phy-ad-hoc-march-to-april-cc.docx>

# 4th Conf. Call: April 15th, 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([11-24-0633r7](https://mentor.ieee.org/802.11/dcn/24/11-24-0633-07-00bn-mar-may-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 [11-24-0633r7](https://mentor.ieee.org/802.11/dcn/24/11-24-0633-07-00bn-mar-may-tgbn-teleconference-agenda.docx).
	+ Discussion: None.
	+ Agenda approved with unanimous consent.
* Technical Submissions – C-TDMA:
	+ [11-24/0093r](https://mentor.ieee.org/802.11/dcn/24/11-24-0093-02-00bn-nav-setting-for-coordinated-tdma.pptx)2: C-TDMA Follow-up Dibakar Das (Intel)

C: Fairness is important, but also the reason we are doing C-TDMA is to deliver much higher levels of quality of service. If everyone supports Wi-Fi 7 or 11be, everyone is helping each other, and this problem just goes away. We definitely need those legacy APs still have a good experience. There are pros and cons. What is your feeling about this?

A: I think we need to have some mechanisms to address the C-TDMA doesn’t create lesser opportunities for the clients.

C: I am not too worried about the problem.

A: If most of the traffic wants to do EDCA and QoS is made by EDCA, what happens in those cases? That could be for the visible 11bn stations, but we also have 11be, Wi-F 7 STAs. Another way to tackle this is just to make sure enough time for EDCA and there's not too much C-TDMA time consumed.

C: In the slide 5, here, after the frame exchange for the shared AP1, it seems that once those frame exchange done, then the sharing AP0 will simply do the CS check. If the frame exchange within this BSS of the AP1 finished earlier than expected, what happens?

A: It seems to me like the returning unused time problem. I’m not proposing any solution here.

C: In the slide 4, the first bullet says, “a small time is needed for the shared AP”. This seems to be ambiguous.

A: I just clarify that the time to detect the PPDU transmission is needed. We need to protect the preamble part just to be safe.

C: This text seems to be misleading. If this text is what it is read, then probably means that the shared AP needs some time to make some scheduling decisions. And then probably we need some kind of upfront announcement to for the shared AP to prepare for the shared TXOP.

C: In the slide 6, regarding fairness aspects, you describe that you are more concerned about a use case where there are other APs in the neighborhood that just contend for the medium. I think that can be easily addressed. If we have a simple requirement such as AP that wins the TXOP is required to first served in BSS stations before it shares the TXOP. That is what we have seen in many contributions. Our contribution says there is a schedule enhancement regime where in this example AP2 notifies or conveys its intention to share TXOP to the AP1, then then it gives the TXOP to the AP1. So, I think that can be addressed. That also the provides here is APs have got some kind of resource requirements of each other. We could bring in simple requirements in the standard.

A: You’re right. I think we need to address is the most extreme case where the AP2 is not even transmitting anything in between every channel transmitting anything. But as the task group, I think we need to make a decision whether that is sufficient. What we are thinking is that we ideally would like to have a limit on the TXOP of the AP2 to be shared.

C: The slide 6 is reasonable to me because the sharing and shared APs know the situation around themselves better. In the slide 7, I totally agree with you that we need to have some rules. For example, we need to have some rules to prevent the sharing AP and the shared AP are occupying the medium for a long time, which may impact on the legacy devices.

C: My comment is the same as the previous commentors. Today, we have similar rule when you want to basically if you have frames queued in different ACs, we have rules that you shall at least transmit one MPDU from one of the ACs before transmitting another frame from higher AC within the same TXOP. We can have something similar here.

A: OK.

C: In the slide 5, the short NAV is used just for the shared AP to respond and also start the initiate this frame exchange within the shared AP’s BSS. Do you think that the sharing APs associated STAs may not here the short NAV and they may start contending the medium after that?

A: What we’re thinking is the shared AP1 will start some frame exchanges and they will set the NAV. So, any STAs that can hear those frame exchanges, they will obviously not be able to contend the medium. They are probably outside the range of those interference problem for the STAs on the sharing AP0.

C: Some OBSS STAs belonged to the sharing AP1 may start contending the medium. And the shared AP is performing the frame exchanges with its own STAs. In my understanding, like C-TDMA, do you think this interference should be protected, or this OBSS interference should be avoided?

A: Are you talking during the allocation time some AP or some STAs are contending to AP0?

C: Right.

A: I think what you are thinking that the shared AP1 will have some frame exchanges. They do an RTS/CTS exchange on the BSS, and the RTS will be heard by any STAs that are associated the AP0. They will set the NAV and not contend to the AP1.

C: It depends on the shared AP if they want to protect the frame exchanges. They can use it but then the simple way may be the sharing AP also set NAV longer enough to cover the whole TXOP.

C: I also don’t prefer to solve the fairness issue because it may add the complexity. It will make the scheduling more complex because the initiator AP should look at other sharing APs. Considering current TXOP limit, it’s not a big concern for the fairness issues. We should keep this part simple.

C: I think I align with direction to use current TXOP limit and to keep the specification simple as well as the other members. In the slide 5, after the frame exchange in the BSS of AP1, you are saying that the sharing AP0 essentially has to do CS to check the medium, right? Why don't we require the NAV is set for a longer duration so that that scenario doesn't happen?

A: You can do that, but the way it works it that if you any solution for do two essentially would imply that you set the NAV and this for longer duration like you said. The question is there is basically a trade-off. If you want the AP0 to get the medium at the end of the TXOP but at the same time it comes costs of medium efficiency.

C: If you want to do RTS/CTS for its own frame exchange, it could set longer NAV, and then it returns a TXOP is still protected. We can discuss more offline.

* + [11-24/0227r](https://mentor.ieee.org/802.11/dcn/24/11-24-0227-01-00bn-txop-protection-in-c-tdma.pptx)1: TXOP Protection in C-TDMA Geonhwan Kim (LG Electronics)

C: It will help to simplify C-TDMA by having one shared AP only, as you mentioned in the summary. In the slide 8, based on suggestion in the previous contribution ([11-24/0093r](https://mentor.ieee.org/802.11/dcn/24/11-24-0093-02-00bn-nav-setting-for-coordinated-tdma.pptx)2), if we limit the number of shared APs to 1 and we want to ensure fairness, we want the sharing AP to finish its transmission first, so if we have these two together, then we don’t need the TXOP return in the end. That will greatly help to simplify the algorithm. My main concern is the overhead. Because many devices are EMLSR devices. So, for AP to share the TXOP, you’re trying to frame exchange within the BSS, we’re likely we are going to have something like a MU-RTS/CTS exchange or PSRP, which results in a lot of overhead to the sequence. Because C-TDMA is mainly targeted for low latency traffic, you can add the TXOP limit is 2 ms only. If we add a lot of control frame, it could be counterproductive.

A: I also worry that some overhead need to be reduced because of low latency.

C: At the AP2, you have the frame exchange within the BSS. For that point we naturally require certain control frames as well. That will provide the protection against hidden nodes around the AP2. It is not only protecting to the AP2, but it also protects the AP2’s client hidden to the AP1 as well. I feel that is simpler and better protection for the AP2’s clients.

A: Thank you.

C: In the slide 6, whether the STA2 is part of BSS of the AP2?

A: The STA2 is not also shared station with the shared AP1. The station is OBSS station but there is AP2’s BSS from the sharing AP.

C: I do want to urge some caution. Because we do see a couple of important use cases with more than one shared AP. The first one is enterprise network; each AP is typically seeing three or four co-channel APs. So, the number of one is quite limiting. The use case is where the AP1 has its remaining TXOP limit with the AP2, and then the AP2 shares its remaining TXOP limit with the AP2, and potentially, so forth, so on and so forth, until we run out of TXOP. I think I’d like us to solve those use cases.

A: This contribution does not limit the number of the shared AP as one. There can be some additional sequential allocation after this sequence.

C: Multi-AP selection shall be behind the frame exchange within the BSS. Where is the multi-AP selection? Do you put at the in the first place?

A: Multi-AP selection procedure is served in the schedule announcement to the shared AP, and it is also mainly used for multi-AP setting for protecting the hidden STAs of the shared AP. So, I just divided the frame exchanged within BSS and this multi-AP selection.

C: If we put multi-AP selection beforehand inner BSS frame exchange, it is better.

A: My intention was that the sharing AP initiates this protection procedures, and then doing its inner BSS frame exchanges.

C: In the slide 6, where you have frame exchanges for the BSS2 for AP2, basic NAV is set by the AP2. In the slide 8, you show a TXOP return. So, I’m assuming this NAV, set by the AP2, has sufficient time which takes care of a TXOP return. Is that correct?

A: This contribution proposes that the short protection and the sharing AP protection is going together.

C: In the frame exchange on the slide 6, when the shared AP sets the NAV, does it include the allocation for doing the TXOP return in this case or not?

A: In this case, the shared AP with that frame exchanges continues until the TXOP return frame is transmitted.

C: We don’t need long NAVs in all cases. There may be some solution where we could have a short NAV, kind of integrated with the baseline schemes such as MU-EDCA. So, that can still solve these issues. In addition, I agree with you on the need of this request and response of announcement frames, which not only helps in this multi-AP solution as well as help kind of shared APs to make efficient scheduling decision for shared TXOPs.

A: I also agree that. In my contribution, AP selection is aligned with scheduled announcement. What was the exactly meaning of the short NAV setting in your comment?

C: For example, in the slide5, you point out the hidden node issues. In this case of right figure, there is the case one where the stations are the hidden node issue for the shared APs right in your dotted rectangle here, we are the shared AP may be busy because there is something like uplink access. If there is the short NAV in the AP2 by the frame exchanges in the AP2, then if the AP2 sets up the MU-EDCA mode to the STAs, then it can set the timer for long duration so that these hidden stations of the AP2 cannot access uplink transmission.

A: If the sharing APs using a short NAV, but the shared AP can be protected by the sharing APs and short frame exchange.

* + [[11-24/0375r](https://mentor.ieee.org/802.11/dcn/24/11-24-0375-00-00bn-nav-protection-for-c-tdma.pptx)0](https://mentor.ieee.org/802.11/dcn/24/11-24-0375-00-00bn-nav-protection-for-c-tdma.pptx): NAV protection for C-TDMA Si-Chan Noh (Newracom)

C: In the slide 5, the last bullet says that the shared AP might not be able to decode or even receive the transmission on the sharing AP. If you go back to the slide 6, the transmission is coming from the hidden STAs, the shared AP won’t even hear that transmission. How does it know when to termite the TXOP?

A: That is the reason why we indicate the situation after the sharing AP receiving the PR enabled from the shared AP.

C: Either you hear the transmission, or you receive a PRI, the first part doesn’t happen, right? You won’t be able to that. We describe the PRI is optional, but if the explicitly sending the PRI frame is great way, I think.

A: The PRI frame can be transmitted optionally.

C: A lot of this thing that problem here can be addressed by employing some of the legacy mechanisms. We don't need to make this overly complicated. There are existing baseline schemes which are quite simple, and they can be employed to address some of the issues you have mentioned here.

A: Thank you for your comment.

C: In the slide 6, you said the shared AP indicates the PRI enabled, and then in the following block, there is the shared APs’ frame exchanges. If the third AP turns to finish all the transmission while it intends to return to the shared AP, it seems that it tries to give TXOP to the sharing AP. What is the design principle here?

A: Whether we consider the fairness issues or not, a sharing AP cannot return TXOP from a shared AP. What I’m trying to do is to give an opportunity to the sharing AP can return this TXOP from a shared AP.

C: In my understanding, the return will happen is only after the shared AP finishes all the transmission, but otherwise why does it intend to return the TXOP?

A: Multi-AP scheme can be considered for support latency sensitive traffic. We assume after the service of latency sensitive traffic, there are remaining non latency sensitive traffic or periodically latency sensitive traffic. In this case, the shared AP still has the remaining data traffic, which is the reason why we assume that kind of scenario.

C: We can talk more offline, but it seems to be a little over complex.

C: What happens if there is a collision at the sharing AP?

A: If the shared AP still has remaining traffic to transmit, it can restart its frame exchange until the end of the allocated time. Or, if the sharing AP cannot receive a return frame, the shared AP did not have any buffered traffic. We can think about these two cases.

C: The shared AP cannot indicate whether the sharing AP received. The shared AP can indicate whether the sharing AP receives retuned TXOP without collision or not.

C: You brought up an interesting point that the shared AP has mixed ACs of latency sensitive and non latency sensitive traffic. In the slide 6, would the shared AP be allowed to share to send the best effort traffic in this TXOP? My assumption is that the sharing AP obtains the TXOP for a voice traffic, which is really for high priority.

A: It depends on the situation. If we consider C-TDMA scenario with multiple APs and the sharing AP already send its TXOP other to the shared AP, I think the shared AP cannot extend this TXOP to support this background traffic. But if there are no another shared AP and if there are no low latency traffic, I think it can be possible. It’s open discussion topic.

C: In the slide 6, how do you make sure the PR indication is transmitted by the sharing AP? How can you make sure that it was not collided?

A: After the shared AP receives TXOP from the sharing AP, you can start the frame exchange and it can be downlink or solicited TB-PPDU. During the frame exchange in the shared AP’s BSS, you can include the PR enable frame in the PPDU. If the sharing AP can receive indication of returning to TXOP, you can choose to send PRI or not. We need more discussion.

C: If the non-AP STAs associated with the shared AP or receive the PR enabled PPDU, then you can also transmit a PRI, then how to resolve the collision from the PRI?

A: If we consider some rules like only the sharing AP and the shared AP can share PR enabled or PRI differently with the non-AP STAs. In that case, the other STAs associated with the shared AP cannot transmit a PRI frame.

C: In the slide 6, there is a time allocation in the initial frame, which is allocated to the shared AP. Does the shared AP keep using the TXOP? It means that it keeps continuous its frame exchange until it can verify that the TXOP is taken over by the sharing AP.

A: There are many ways to decide when the shared AP return its TXOP to the sharing AP. In this contribution, we assume that the shared AP decides to try to return its TXOP at the support of the last buffered latency sensitive traffic.

* + [11-24/0382r](https://mentor.ieee.org/802.11/dcn/24/11-24-0382-00-00bn-further-considerations-on-coordinated-tdma.pptx)0: Further Considerations on Coordinated TDMA Serhat Erkucuk (Offino)

C: In the slide 7, would this problem exist when we develop this feature? We actually see the sharing AP shall finish its traffic before the sharing TXOP, which wouldn’t take care of most of these issues, because then only the shared part of the TXOP will appear at the end of the TXOP.

A: At this time, the sharing AP does not have any buffer data for the STA1.

C: I see what you’re saying is the AP1 does not have any data buffer.

A: Although it may share for fairness issues or other issues, we can share the TXOP with the shared AP and then it may have buffer data. This is the case where the shared AP does not fully use its allocation and may want to return earlier.

C: I think it is better to send all of the data earlier in a TXOP and then to share the remaining TXOP, if applicable. In the slide 6, the STA2 is sending a CF-end with the transmitter address of its own AP, but I’m not sure this is a good idea. It seems tricky.

A: I agree that. It’s not conventional. But in this case, this is the shared AP triggering the STA2 to which to send this data. If any of the STAs doing uplink transmission which could accept this basic NAV, we’ll be able to reset the basic NAV. I mean this requires some different changes.

C: In the slide 7, the STA1 has its basic NAV by hearing the STA2. My expectation would be it is in power save mode, right? Typically, there is an extra behavior for 11bn STA not to be in power save and the NAV is set like that it can hear trigger and then send uplink data. That behavior should not be in power save.

A: Although it may set its basic NAV during the frame exchange of AP two, it may be able to respond only to the trigger frame or any frame, RTS frame or other frame coming from only the sharing AP.

C: I think it's not going into power save in this case because it's monitoring the trigger from the AP.

A: Right.

C: Typically, the sharing AP first finish it’s traffic from its own BSS. Why are there needs to get back the TXOP and then trigger its associated STAs? Typically, the STA1’s traffic is solicited before sharing.

A: I think this question is similar to the first one. In some cases, the frame exchange between the AP1 and the STA1 to finish the data transmission and then pass the TXOP. Although there's still TXOP duration for the shared AP, it may want to return because it doesn't have more data to send. In this case, the sharing AP could have new downlink frame or triggered uplink or requesting uplink frame from a STA. So, within this duration, new data could be buffered.

C: But there is new buffer data, then the AP1 may not have this information. What does the AP1 know the new-coming buffered data from STA1 side if it happens during this TXOP?

A: If there is sufficient time, it is very likely that it can send a downlink frame if there is newly buffered traffic.

C: In the slide 7, we set the NAV by hearing the STA2 and then now we ignore that. What’s the metric that allow the AP1 can ignore the NAV? How does the STA1 know that?

A: I mean this would indicate within the duration of the BSS2’s frame exchange. You can ignore like this is the MU-RTS TXS trigger frame allocation to the shared AP2.

C: Thank you for your comprehensive analysis. We want to keep it simple by having the TXOP for the sharing AP to finish its own traffic, which will help us avoid all these complex corner cases.

C: If the shared APs are set only short NAV in the trigger frame, then we can use the other baseline behavior to solve this problem. But mainly all these issues are coming that from the trigger from setting the NAV.

A: I agree on that point.

C: In the slide 4, as I know in the baseline, if the STA set the NAV due to the TXOP responder, maybe in this case to the STA2, although it cannot receive the CF-end frame. But I think it maintains to the NAV in the baseline. I just wonder we also need to handle that case in the C-TDMA cases.

* + [11-24/0411r](https://mentor.ieee.org/802.11/dcn/24/11-24-0411-00-00bn-txop-return-in-c-tdma.pptx)0: TXOP Return in C-TDMA Geonhwan Kim (LG Electronics)

(The presentation was postponed due to lack of time.)

* Adjourned at 21:00.

# 5th Conf. Call: April 18th, 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([11-24-0633r8](https://mentor.ieee.org/802.11/dcn/24/11-24-0633-08-00bn-mar-may-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 [11-24-0633r8](https://mentor.ieee.org/802.11/dcn/24/11-24-0633-08-00bn-mar-may-tgbn-teleconference-agenda.docx).
	+ Discussion: None.
	+ Agenda approved with unanimous consent.
* Technical Submissions – C-TDMA:

* + [11-24/0411r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0411-00-00bn-txop-return-in-c-tdma.pptx): TXOP Return in C-TDMA Geonhwan Kim (LG Electronics)

C: Why do we need to have this explicit TXOP return? If you keep the protocol simple, then we could just rely on some PIFS recovery rules. If the sharing AP and the shared AP typically hear with each other, most of the time it will work. So, I was wondering what you think about that. Also, another possibility is that the sharing AP simply give the allocation at the end of its TXOP. In that case, there is no need for a return frame and every sharing AP gives some remaining TXOP to the other shared AP. The shared AP does whatever it wants, and the sharing AP does regular back off procedure. This means there is no need for extra procedure in those cases.

A: I am also aware of that point. If we divide the cases one and two, I think it will be the better way if the shared AP can use the allocated time elaborately. So, I just bring this point.

C: I mean there is a way without a return frame.

A: We need to discuss on that point.

C: I have similar comment to the previous one. I think it is redundant. Because in C-TDMA, the sharing AP is already aggressive to occupy the TXOP. If the shared AP finish to transmit its traffic earlier, it is better to release the leftover TXOP to the other BSSs. Occupying too much resource causes some more fairness issues. It is better to make the protocol simple.

A: Thank you for that comment.

C: In the slide 7, you assume to use the MU-RTX TXS TF. Is the duration of the frame at end of the CTS or the whole TXOP?

A: Both cases also make sense to this kind of issues.

C: If the shared AP returned the medium time, what is the sharing AP’s behavior?

A: In that case, the sharing AP is doing a CCA with PIFS interval and if the channel is idle, then it can use the idle channels. If the channel is busy, it invokes backoff procedure.

C: What I am asking is that the TXS duration will come cover CTS or whole TXOP. I think the whole TXOP is fine. But otherwise, it may be too aggressive. We need to consider this simple designs.

A: Thank you for your comment.

C: Specifical to the first question, we definitely want to consider the case of multiple cases, probably with different periods in general, spread across multiple BSSs. And the goal is to deliver that traffic as low latency as possible. To my mind, the right target here is for the TXOP holder to be able to share to multiple APs at a time not just one. Also, another use case is that the first AP shares to the second AP, and then the second AP can directly share with the third AP, and the third AP can directly share with the fourth AP. In all these cases, we would achieve fairness just by constraining everything to last up to the TXOP no further.

A: To multiple shared APs support cases, the AP2 sends the next MU-RTS TXS TF to the shared AP.

C: There will be a part of it. But, in other flows, the second AP could directly grant it to the third AP. I think that is a vital topic, especially when you are going from the second to the third AP.

A: I was open to the multiple support case. We also need to discuss and check any protection issues. If we apply the multi-AP support cases, there are two types of return.

C: If the shared AP is done its transmission earlier, then we should design our protocol where the TXOP can be returned, or as the previous comment said, we should pass to the third AP. I think if the sharing AP does all its exchanges before it shares TXOP, then we don’t need the TXOP return. We should also account for scenarios where new latency sensitive traffic can arrive during the TXOP. On the fairness part, if we limit this to the TXOP limit, and then we basically conform to that limit. So, we address the fairness from that perspective.

C: In the slide 4, what is the difference between the second and the third options, the management frame using an A-control field and an action frame? Are you saying that the third option is that it is an explicit defined a frame for return?

A: It is referred from the previous contribution from us. It can be used for especially for this kind of things.

C: I think it is too early to decide whether we need an explicit return or not. I can see some use cases where it helps to have a return and then let the sharing AP decide what to do next. I am generally supportive of the direction.

A: I agree that the applicable cases are depends on the situation. I am open for the options.

* + [11-24/0423r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0423-00-00bn-nav-rules-in-c-tdma.pptx): NAV Rules in C-TDMA

 Sanket Kalamkar (Qualcomm Technologies Inc.)

C: In the slide 4, you mention the announcement frame. My understanding is that you need to announce first and give some time for the shared AP to do the scheduling. After it is granted some time, it can do the transmission. Is this right?

A: Yes. That is the idea of meaning that it helps to give sufficient information for the shared AP to make some time or the efficient scheduling decisions.

C: Does the in-BSS station associate with the sharing AP?

A: Yes.

C: Why do you need to indicate that?

A: There may be other cases. For example, you want to do your in-BSS transmission and then probably you can use the same schedule announcement frame to tell that the sharing AP starts some transmission. One example is EMLSR case. The same schedule announcement frame can be used. And also, the schedule announcement improves the efficiency of the C-TDMA transmission rather than you never use this schedule announcement frame to identify these shared APs.

C: So, is your plan to use the initial control frame like MU-RTS or BSRP to serve as the schedule announcement frame?

A: There are some options, but it is TBD. We have not yet agreed what would be the frame for the schedule announcement.

C: You need an extension of the baseline TXS frame to provide the exact duration of the shared TXOP. What is the duration of the shared TXOP? What is the difference between this and the allocation time?

A: We can use that allocation duration as well as in the TXS frame to provide this exact duration, but also it is something like the traffic priority. These are the just examples, but there may be some additional information that we could provide using the TXF or allocation frame. We might need the extension, but this is currently an open topic.

C: In the slide 3, do you assume any kind of expectation setup before all this kind of frame exchanges within the TXOP? Is there any basic expectation between the AP1 and the AP2?

A: Probably, I think you are talking about the long-term thing, not just of the TXOP level, right?

C: Yes.

A: There may be possible some pre-communication before this TXOP. It’s quite open area as of now. But that is certainly a possibility that the AP1 and the AP2 have done some of negotiations beforehand. Those are the long-term negotiations, and those things may often change in short-term.

C: You are saying that it could be a possibility, but not a requirement, right?

A: It is too early to decide since we haven’t gone to those discussion.

C: Do you assume that this kind of allocation is like an ad-hoc basis, like a best-effort basis?

A: During the TXOP, the traffic condition may change. So, we still need this announcement and then the allocation frame should take care of those changes happening within a TXOP level.

C: About the schedule announcement within a TXOP, so, I believe the idea is to give the TXOP to another AP so that they can reorient their resources to receive, right? Why do we need this separate schedule announcement?

A: There are multiple shared APs that it needs to also identify those shared APs that it needs to identify those shared APs and then also there could be multiple clients.

C: Why aren’t we allocation the multiple user indication within the MU-RTS TXS? You can indicate those multiple users in the same trigger frame.

A: It could be possible, but it may not be as efficient as possible if the scheduler announcement frame can provide that information. That is also complex. The TXOP allocation frame also cannot provide the schedule announcement for C-TDMA. There are also hidden node issues that can be also elevated using the schedule announcement.

C: In the slide 5, the AP2 sends the CTR as a response. Is one purpose to set the intra-BSS NAV so they want to forbid spatial reuse feature?

A: It is not a forbidding the reuse feature. In fact, there could be. One simple solution will be the

AP2 accepts that RTS request only if it has sufficient time before this TXR allocation frame. We can have kind of a controlled spatial reuse that is for the stations associated with the shared AP or the sharing AP. We are not completely forbidding spatial reuse.

C: But if inter-BSS NAV is set, the AP can transmit something.

A: This is a baseline behavior. We want to stay close to the baseline as much as possible as.

C: I think sharing TXOP is a pretty effective solution. In the slide 7, you have employed one or more baseline mechanisms on the standard. These are good in terms of the RTS enablement. Whether the shared AP would either send a CTS or not, and if the client asked for too much time, then there will be not in any circumstances. To extend special reuse as possible, are you assuming that during the multi-AP setups the AP would just respond neighbors with CTS or sometimes it would try to respond with CTS based on spatial reuse?

A: Are you asking for this RTS enablement?

C: Yes.

A: It depends on the location of this estimated time of this TXOP allocation frame. If there is the RTS and if the duration in the RTS exceeds this boundary, probably the shared AP may not want to respond.

C: OK. One more potential idea is recalled, a client uses an RTS and responding CTS but only till TXOP, which is useful for client. I think would also be very valuable here and would make a little bit more efficiently.

A: That seems possible. We can talk about what can be done to enhance.

C: In the slide 6, what you mention here is that the hidden nodes are stations associated with the sharing AP or the shared AP. In my opinion, this is possible that station from the other BSSs or BSSs will occupy the wireless medium during the ongoing transmission. In the slide 7, there is still the issue.

A: I agree with you there are the hidden node issues like this baseline mechanisms helps us alleviate the hidden node issue within the BSS of shared data and the sharing AP. But we need more thinkings also, like how to pick up the OBSS hidden node issues.

C: In the slide 6, you are trying to solve the hidden node issue from the shared AP and also the shared AP. In this TXOP, for the first part, the AP1 is direct transmission, but in order that the AP2 can cancel the remaining part to protect the AP2, but either case is that the other STA around the AP2 will be silent. So, nobody will use a medium at this area. Similarly, we want to protect the sharing AP so that the latter part of the TXOP, but some STAs around the AP1 cannot fully use medium in that procedure.

A: Are you talking about the STAs associated with the shared APs or the sharing AP? There are all the hidden stations.

C: I assume that there’s another BSS, the AP3.

A: Based on the motivation in this contribution, we are not proposing any long NAV for these new to the schedule announcement. As we discussed in the last January meeting, if we have to set a long NAV due to the schedule announcement frame, and then TXOP allocation frame that may hinder the other stations from accessing the medium better performing spatial reuse. That was one of the motivations for this presentation.

C: In the slide 4, you say that there is estimated start time of sharing. Is this like through a TSF time stamp which you are indicating in the schedule announcement for each AP? How is the estimated start of sharing indicated? When you send the TXOP allocation using the TXF frame, could that be different?

A: It could be because there are in-BSS transmissions preceding the TXOP allocation frame. There is being wireless and there is some uncertainty like how long this transmission will take, for instance, there is a retransmission happening. That probably extends this message a little weak. It’s just kind of rough heads up to the shared AP.

C: If there is some pre-coordination between these APs and some knowledge of it, how much QoS traffic in each has and then schedule announcement could make use of it? Have you thought of that?

A: I think that’s one of the possibilities. We have not decided on these things but means the idea of what you are saying is that it’s right.

C: I think the shared AP could provide such information in a CTR frame.

A: I totally agree.

C: Do you think this announcement as mandatory, or just optional?

A: We think the needs of a schedule announcement frame for the multiple reasons, and we see a great value having it in this operation.

C: What if the shared AP cannot respond to this announcement?

A: I mean that a schedule announcement is transmitted at the first frame, if it fails, then overall takes off will fail. That’s right. You can use the scheduled announcement frame to kind of a polling frame for not only for the AP that are participating in-BSS STAs. It serves two purposes. First, it reduces the probability of no response to this schedule announcement frame because it solicits the responses from multiple entities. The second, it improves the efficiency because now it is a kind of “killing two birds in one stone.” I mean, one for the sharing AP soliciting the responses from the shared APs as well as the responses from in-BSS STAs.

* + [[11-24/0](https://mentor.ieee.org/802.11/dcn/24/11-24-0284-01-00bn-low-latency-low-collision-low-power-uhr-medium-access.pptx)284r1](https://mentor.ieee.org/802.11/dcn/24/11-24-0284-01-00bn-low-latency-low-collision-low-power-uhr-medium-access.pptx): Ultra-reliable PHY elements: Low latency, low collision, low power

medium access

Seán Coffey (Realtek)

(Sean was not present. The presentation was postponed.)

* + Chair called for proposal to presentation.
		- Nima offered to present [11-24/0067r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0067-00-00bn-range-expansion-via-repeated-transmission.pptx).
	+ Chair modified the agenda to add the submission.
		- The modified agenda was approved without objection.
	+ [11-24/0067r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0067-00-00bn-range-expansion-via-repeated-transmission.pptx): Range Expansion via Repeated Transmission

Nima Namvar (Charter Communications Inc.)

C: Do you assume that the receiver combines those two PPDUs in different TXOPs?

A: Correct.

C: It’s like some HARQ procedure. It needs to assume the receiver needs to store the previously received signals in memory, which is a little bit tricky. I remember the time when we discussed HARQ, that’s some burden for receivers.

A: I agree with that. Actually, that requires to restore this replica as before. We have left the room open for different repetition schedules. We can do it over time or over frequency any different and it definitely depends on the applications and the implementation scenarios.

C: I agree that there are different options can be considered.

C: If the repetition process happens in the time domain, they can happen over to multiple TXOP and not necessarily within the same A-PPDU. In this case, how do you envision the acknowledgment process to take place?

A: A simple solution is that we can have acknowledgment frames for both two frames. We can potentially discuss how exactly the acknowledgment process would work in such a scenario.

C: We already have different modulation coding schemes that offer higher reliability. And there are PPDU formats that allow repetition in the frequency domain, that allow the duplication. That’s one way to improve the efficiency. If you want to go beyond current standard, isn’t the bottleneck going to be the PHY preamble detection etc.?

A: But that duplication is allowed for one duplication. Even if you go with MCS0 with the quarter of half and even BPSK, there is so much that we can do for the range. This rate versus range is one of those one of the KPIs. Potentially, there would be rooms for sacrificing a little bit more of a data rate compared to MCS0 by taking advantage of some more elaborate and more sophisticated repetition schemes in order to improve the range.

C: In this case, my concern is that the PHY preamble detection becomes the bottleneck.

C: You suggest adding some field in the U-SIG. Do you mean if we define the PPDU format or define the field in the UHR PPDU?

A: In the U-SIG. The reason is that in order to take advantage of this repetition scheme, what we need first is to have both the transmitter and receiver to be on the same page, regarding which part of the duplication being time or frequency is duplicated. We are just proposing an extra field in the U-SIG in order to signal exactly what would be the repetition scheme.

C: We need more results about how much gain can be obtained by your proposal.

A: The repetition scheme is nothing new. If you want to use the repetition is specifically to increase the SNR. If you are solely focused on SNR, it depends on how many repetitions we have. If we can coherently combine them, then we will get the SNR increase in a log-arithmetic way.

C: As you mentioned, these are ideal case. The real case is different from the ideal case.

* Adjourned at 11:44

# 6th Conf. Call: April 22th, Thursday (19:00-21:00 ET) – MAC/PHY

* Split MAC and PHY ad-hoc teleconferences.
* MAC: (To be available)
* PHY: <https://mentor.ieee.org/802.11/dcn/24/11-24-0641-02-00bn-minutes-tgbn-phy-ad-hoc-march-to-april-cc.docx>

# 7th Conf. Call: April 25th, Thursday (10:00-12:00 ET) – MAC/~~PHY~~

* Split MAC and PHY ad-hoc teleconferences.
* MAC: (To be available)
* PHY: Cancelled

# 8th Conf. Call: April 29th, 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([11-24-0633r12](https://mentor.ieee.org/802.11/dcn/24/11-24-0633-12-00bn-mar-may-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 [11-24-0633r12](https://mentor.ieee.org/802.11/dcn/24/11-24-0633-12-00bn-mar-may-tgbn-teleconference-agenda.docx).
	+ Discussion: None.
	+ Agenda approved with unanimous consent.
* Technical Submissions – C-RTWT plus Medium Access:
	+ [11-24/0160r1](https://mentor.ieee.org/802.11/dcn/24/11-24-0160-01-00bn-r-twt-coordination-negotiation-in-multi-bss.pptx) R-TWT Coordination Negotiation in Multi-BSS

 SunHee Baek (LG Electronics)

C: I agree with we should reuse most of the R-TWT and the broadcast TWT to set the parameters. In the slide 7, I am curious about the announcement of coordinated R-TWT SP for the cases 1 and 2. Is that a joint transmission or separate transmission?

A: It depends on how to negotiate the overlap during the R-TWT.

C: Is this a part of the coordinataion request and response?

A: Yes.

C: I am worried about the particular design in terms of the scalability. If you have two neighbors, probably it can be done. But I’m not sure how we have three or more neighbors. Do you have any thoughts on that?

A: If there are several APs, they should negotiate one by one.

C: We are assuming that a negotiation leads to mutually agreeable solution. But I worry about overlap issue. Let’s consider two neighboring APs and they want a slightly different service interval. Those desired service periods with the nominal service period duration will overlap. That’s a low probability event in case of just two flows. But when we support four, five, six or seven APs, each of them with two, three, four and five flows, the overlap event happens quite often. When you have overlapping service periods, how do you expect the system to resolve itself? I think one option is they just sort of take turns of priority. Another option is everyone agrees on the same service interval.

A: Basically, the R-TWT is defined in the single BSS. We need think about expanding two overlapped BSS. Then, expanding three, how to connect the three ones.

C: When each AP protects its own flow, sooner or later, the service period will overlap. Do you have a solution for that?

A: I think it is related to channel and bandwidth.

C: Same channel, same bandwith and same time.

A: At the time, they could negotiate it overlaped R-TWT and then they can use the AP coordination scheme or not stay competitive to obtain the TXOP.

C: I'm trying to understand the motivation of this negotiation. In the slide 3, is this negotiation for non-overlapping R-TWT?

A: Right.

C: Why do not just the one AP overhear the R-TWT schedule on the other AP then try to avoid the overlapping?

A: During the R-TWT coordination, they negotiate the agreed about each OBSS to protect in the BSS. So, the stations which belong to AP1 will stop before then.

C: Only after the negotiation, the AP will do protection for the other AP, right?

A: Yes.

C: When the AP2 has co-hosted BSSID and if we want to negotiate on one by one, that will cause terrible overhead, how do you consider that?

A: I think the broadcast is not possible to negotiate on R-TWT. For example, if the AP1 finishes negotiating with the AP2, then the negotiation of the AP3 with the AP1 is scheduled on the AP1’s resources.

(Comments and answers on the chat window --- from here---)

C: We must consider overlapping cases.

C: R-TWT would not be the right tool to address the situation. There is a tradeoff.

C: Absolutely, we can see this working well in manufacturing etc. in isolated sites with a wider border and with device entry controls. That's a use case we want to solve, but we acknowledge that it is somewhat narrow - so we'd certainly also like a solution for the broader / more typical scenarios.

C: The best the APs can do in that situation is to align the SPs in two BSS and open up the scehdule for membership for the LL STAs in the respective BSS' schedule.

C: But again, there is tradeoff of the need to compete with other LL STAs in the neighboring BSS.

C: Rather than aligning, I would use phrase it as same coordinated schedule. If there are STAs in both APs running 60 Hz video (e.g.,), it is better served with one coordinated schedule than both APs setting up separate schedules whose SPs may sometime overlap as well.

C: We can use other coordination mechanisms to have more efficient medium access between APs (like TXOP sharing) during these SPs

C: I think rTWT SP are used for protection, not scheduling. Other mechanism shoul be used for scheduling.

C: R-TWT is both a schedule of periodic SPs, and also a protection mechanism for start of these SPs.

C: The fear I have with aligning SPs is

1. beacon intervals don't align with most QoS flows :-(,

and

1. worse, typically AP1 sees AP2 sees AP3 ... sees AP1000.

Is 60 Hz (or whatever) globally acceptable to all these APs?

C: Agreed. And the protection mechanism for the start of SPs remains very valuable.

C: OBSS protection though can easily do an overkill and reduce mediuim efficiency.

C: Certainly, some level of prioritization may be needed as one possible way whilst some interval would be possibly overlapped in case of such large number of coexisting neighboring APs (maybe some other solutions like C-SR together helpful if overlapped issue is critical, we're open for those ones). Since original rTWT was designed for a single AP so, surely, it's needed to be extended for that purpose as Sunhee pointed out.

C: on b), tbh, I see C-RTWT to be applicable within a limited number of APs only. R-TWT has known scalability issues.

C: Scalability of any schedule coordination will be limited and should be used depending on scenario.

C: I think we are over designing this feature. It can be as simple as AP1 broadcasting its schedule in Beacon (with an extra flag we define in UHR that signals ‘alignment preferred’). AP2 that hears it tries to align its R-TWT schedules. (Important word - tries). It is kind of best effort at this point. If AP1 & AP2 belong to the same ESS and managed by the same entity, it is easy to align them in the first place. If they don’t belong to the same ESS then it is best effort anyways!

(Comments and answers on the chat window --- to here---)

* + [11-24/0161r1](https://mentor.ieee.org/802.11/dcn/24/11-24-0161-01-00bn-r-twt-announcement-in-multi-bss.pptx): R-TWT Announcement in Multi-BSS SunHee Baek (LG Electronics)
		- The presentation was conducted.
		- There was no questions and comments.
	+ [11-24/0388r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0388-00-00bn-impact-of-network-topology-on-coordinated-r-twt.pptx): Impact of Network Topology on Coordinated R-TWT

 Qing Xia (Sony Corporation)

C: In the slide 5, I agree with a service interval in automated manufacturing. But we need to understand what service creates overlap and then to have a protocol. In your proposal, the service periods may need to slide or be rescheduled or even be paused and restarted. We do need to try to incorporate that naturally and efficiently, at least so that clients understand what's going on like go to sleep or something like that.

A: I agree that more efficient protocol should be provided especially when we are considering coordinated mechanism between OBSSs. But I also think it’s a benefit we can get it to use more resource and we can have more fiexibility in using the resources instead of postponing it.

C: I think taking priority is important. Who does rescuedule the resouces based on priority?

A: It could be achiceved that for example, if we can reschedule like one previous member of R-TWT to a different R-TST SP. When we consider the overlapping and reschedule, certainly there are some more parameters such as priority should be taken into consideration.

C: In the slides of Case A and B, I agree with the R-TWT interference is very much denepdent on topology. But for Cases A and B, I was wondering whether you have any assumptions about topology discovery or some kind of ideas to figure out where they are. Do you assume any protocols that are missed in your presentation?

A: I think more accurate way to put it, it is based on the interference like RSSI or some other level of interference detection. I don’t have any specific set of how to design this and it is still open.

C: Basically, you need to have some sort of a topology discovery first.

A: Right.

C: For this R-TWT SP reschedule, R-TWT may have periodic scueduling. Do you try to reschedule this particular SP or the series of SPs?

A: I am trying to reschedule any potential overlapped SPs. For example, if we have multiple OBSSs, it is possible that we may have a continuous R-TWT SPs from those multiple OBSSs as well. In that case, you may need to consider not overlapping with two R-TWT SPs. You may need to consider a wide overlapping like your R-TWT SP from the intended BSS with all those like a multiple OBSS R-TWT SPs.

C: You mention that you want to reschedule this R-TWT SP in a whole. Can you elaborate how do you reschedule them in a whole?

A: We can do some R-TWT negotiation between the AP and this associated STAs. It makes similar with what is specified in current 11be spec.

C: How about overhead?

A: It is still opening designs.

* + [24/0407r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0407-00-00bn-r-twt-multi-ap-coordination-follow-up.pptx): R-TWT Multi-AP Coordination - Follow up Kumail Haider

C: In the slide 10, in this case, if the AP1 and the AP2 can’t hear with each other, what happens? If the AP1 indicates trigger-based functions like TXOP sharing between the STA11 and the STA12, during the R-TWT SP that is scheduled by the AP1.

A: I think the key here is that from the R-TWT coordination prespective, all the coordination that is happening at this SP start boundary, and the sort of negotiatnin or the agreement between the two APs. In this case, the AP1 controls the coordination. The AP1 also announces the schedule in its own BSS and assuming that these STAs are also supporting R-TWT. So, then all these nodes in the overlapping BSS are ending their TXOP at the SP start. Now the operation that happens within the SP. The idea here is that this may be dictated by some other coordination mechanisms like coordinated spatial reuse or coordinated TDMA. I think that is beyond the strict topic of R-TWT coordination. From R-TWT perspective, the key here will be the ending of the TXOP at this boundary. But here we wanted to show spatial reuse or TXOP sharing may be used in this case.

C: Regarding R-TWT, does it mean the shared AP always takes some transmission opportunity during whole TXOP?

A: I think the sharing AP and the shared AP terms have been used in a different context from some other presentations. In this context, the sharing AP is on that owns the schedule or the schedule origin belongs to the sharing AP’s BSS. When the first AP is asking the second AP on coordination orschedule, the schedule originated by the first AP’s BSS. I call it as the sharing AP. The AP is requested to coordination is called the shared AP. I think this is not extending my context and not extending to the TXOP sharing aspect. From a TXOP sharing perspective, it is definitely possible that TXOP sharing request may originate from any of these AP.

C: I think the goal of all these coordination mechanisms is really to improve the costs. The long tail of the latency CDF should be avoided. So, you’re indicating that we don’t need higher assurance or higher requirement on the client side. But I think it would be advantageous if we had greater ability to schedule the medium to make sure this traffic gets through on time. You mentioned one approach of advertising by beacons. Some of the other ones including triggered access in general or peahaps like RTS required or an AP may not respond. Have you thought about the possibilities of them?

A: Are you suggesting some of those other mechanisms as mechansisms between multiple APs or operations within the BSS?

C: Within the BSS.

A: I think the focus in the slide 8 is again like we acknowledge the possiblity that not all the station within a BSS may be R-TWT supporting STAs.

We can use this as coordination mechanisms between the APs at least at the AP level, they can coordinate, for example, they can end the TXOP and better manage the medium access. The operation within the BSS, R-TWT is a strong candidate, but we can have other mechanisms. I think this presentation is more focused on coordination between the APs, rather than operation within the BSS. But certainly R-TWT is a good candidate.

C: R-TWT is like take it or leave it kind of thing. If we have overlapping service periods, and the previous AP has a long TXOP, the AP’s service period may need to slide right.

On top of R-TWT, I think it will be really informative and powerful to help AP coordination.

A: I agree. These methods can be used as complimentary to manage operation within the BS and share further information between the BSSs as well.

C: If only Level 1 was applied, then which benefit we can expect without Level 2?

A: The main motivation behind Lelvel 1 is basically that the APs are considering other APs schedules to devise its own schedules. It is already possible to do it within the 11be. But this is kind of emphasizing that, this is more about schedule sharing. The schedules may also be shared in unicast frames, and then it is a request for the other AP to minimize interference. In Level 2, this may actually be a part of a negotiation or a kind of reassurance from the other AP as well. It's a commitment and the TXOP all the other APS schedules. This is a kind of a higher level of protection. But from the perspective of taking action by the shared AP, Level 2 is the one that actually has an expected behavior to do.

C: If the AP1 initiates a coordination but the AP2 rejects this, what would the AP1 do? Would it schedule for R-TWT SP or just cancel this?

A: AP can manage its own BSS and operate as it like, and then regarding the coordination, I think any coordination will be starting wihthe request. Whether the other AP is willing to coordinate, then the operation can happen at a higher level of protection. Otherwise, the AP can simpliy behaves as a standalone operation in its own BSS. The main benefit of the APs is to devise a negosiated schedule instead of having separate schedule. For example, if we do streams with 60 Hz, the schedules have similar intervals. In this case, coordinated scheduling is more efficient rather than having separate schedules, which may overlap. And we can consider this in term of ESS operation, or as a part of enterprise policy. In those cases, having flexibility to devise a schedule before start announcing is defitely useful for me.

C: In the slide 13, regarding the straw poll 1, what is the motivation to extend the SP starte time protection what is the missing part compared to the current SP start time protection in 11be?

A: The intention of the extension is not just within the BSS but also to the other APs.

It's not changing the start time protection rule, but just applying it to R-TWT.

C: In the slide 10, if the STA11 initnated before the SP because it does not receive storing interfence from the AP2, that is still need to terminate a TXOP before that R-TWT SP?

A: My current thought is that; if two APs agree to coordinate on R-TWT, then the start time protection rule should apply. Because it’s not guaranteed that no interference is caused. I think it should apply in any case.

C: Regarding Level 2, the APs will end their TXOP at SP start boundary. Does this assume that there are no overlapping SPs?

A: If it is overlapping in terms of this exact same start time, then ending TXOP for one will mean ending for both. And if it is like they are very closely spaced start time and their APs agree to coordinate, then you will have the TXOP at both of thoese start time. That is the current application of the rules.

(Comments and answers on the chat window --- from here---)

A: the coordination is schedule level in context of R-TWT, which requires the coordinating AP to end any on-going TXOP at start time of an R-TWT SP.

C: R-TWT SP sharing AP and shared AP is confusing. Sounds like the sharing AP announces the SP and shares it with shared AP.

A: thanks for the feedback. I will revise that slide to clarify the context.

C: to achieve level 2, do we need AP to AP communication to enable the coordination?

A: AP-AP communication is not strictly required as schedules can be learnt via beacons. But if such communication is possible, it opens up new possibilities for schedule sharing and coordination/more info etc.

C: We may want to evaluate the potential gain and the overhead we have to pay

A: acked the concern. I think it's a tradeoff between enhanced protection+coordination vs standalone operation. We can continue to study further. But there are certainly scenarios where coordination between APs will be advantageous for overall efficiency and low latency traffic delivery.

A: agree about overhead concern. We should keep signaling as compact as possible, and strictly need basis. But having such signaling is beneficial overall.

C: whether Level 4 for txop-level coordination during SPs needs to be considered?

(Comments and answers on the chat window --- to here---)

* + 24/0284r2 Low lat., low collision, low power UHR medium access Sean Coffey
		- The presentation was finisued.
		- But there was no remaining time for questions and comments.
* Adjourned at 21:00

**Appendix**

* Attendee List for the 5th Conf. Call:

|  |  |  |  |
| --- | --- | --- | --- |
| Breakout | Timestamp | Name | Affiliation |
| TGbn | 4/15 | Adachi, Tomoko | TOSHIBA Corporation |
| TGbn | 4/15 | Ajami, Abdel Karim | Apple Inc. |
| TGbn | 4/15 | Anwyl, Gary | Mediatek Inc |
| TGbn | 4/15 | Asai, Yusuke | Nippon Telegraph and Telephone Corporation (NTT) |
| TGbn | 4/15 | Asterjadhi, Alfred | Qualcomm Incorporated |
| TGbn | 4/15 | Baek, SunHee | LG ELECTRONICS |
| TGbn | 4/15 | Baykas, Tuncer | Ofinno |
| TGbn | 4/15 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | Carney, William | Sony Group Corporation |
| TGbn | 4/15 | Cha, Dongju | LG ELECTRONICS |
| TGbn | 4/15 | Chen, Junbin | TP-Link Corporation Limited |
| TGbn | 4/15 | Chen, You-Wei | MediaTek Inc. |
| TGbn | 4/15 | CHENG, yajun | Xiaomi Communications Co., Ltd. |
| TGbn | 4/15 | Cho, Hangyu | LG ELECTRONICS |
| TGbn | 4/15 | Choi, JinHo | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | Choi, Jinsoo | LG ELECTRONICS |
| TGbn | 4/15 | Choo, Seungho | Senscomm Semiconductor Co., LTD |
| TGbn | 4/15 | Chu, Liwen | NXP Semiconductors |
| TGbn | 4/15 | CHUN, JINYOUNG | LG ELECTRONICS |
| TGbn | 4/15 | Coffey, John | Realtek Semiconductor Corp. |
| TGbn | 4/15 | Cui, Yaoshen | TP-Link Corporation Limited |
| TGbn | 4/15 | Das, Subir | Peraton Labs |
| TGbn | 4/15 | Dong, Xiandong | Xiaomi Communications Co., Ltd. |
| TGbn | 4/15 | Ekkundi, Manasi | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | Erkucuk, Serhat | Ofinno |
| TGbn | 4/15 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbn | 4/15 | Fang, Yonggang | MediaTek Inc. |
| TGbn | 4/15 | feng, Shuling | MediaTek Inc. |
| TGbn | 4/15 | Gao, Ning | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/15 | Ghosh, Chittabrata | Apple Inc. |
| TGbn | 4/15 | Goto, Fumihide | DENSO CORPORATION |
| TGbn | 4/15 | Gu, Jaheon | Samsung Electronics Co., Ltd. |
| TGbn | 4/15 | Gu, Junrong | Clourney Semiconductor |
| TGbn | 4/15 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbn | 4/15 | Gupta, Binita | Cisco Systems, Inc. |
| TGbn | 4/15 | Ha, Taeyoung | Samsung Electronics Co., Ltd. |
| TGbn | 4/15 | Haider, Muhammad Kumail | Meta Platforms, Inc. |
| TGbn | 4/15 | Hansen, Christopher | Covariant Corporation |
| TGbn | 4/15 | Helwa, Sherief | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/15 | Hsu, Yung Lin | National Taiwan University |
| TGbn | 4/15 | Hu, Chunyu | Spreadtrum Communications US |
| TGbn | 4/15 | Huang, Po-Kai | Intel Corporation |
| TGbn | 4/15 | Inohiza, Hirohiko | Canon |
| TGbn | 4/15 | Jee, Anand | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | Jeon, Eunsung | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | Kakani, Naveen | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/15 | Kalamkar, Sanket | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/15 | Kamel, Mahmoud | Interdigital Inc. |
| TGbn | 4/15 | Kim, Geon Hwan | LG ELECTRONICS |
| TGbn | 4/15 | Kim, Jeongki | Ofinno |
| TGbn | 4/15 | Kim, Sang Gook | LG ELECTRONICS |
| TGbn | 4/15 | Kim, Youhan | Qualcomm Technologies, Inc. |
| TGbn | 4/15 | Kishida, Akira | NTT |
| TGbn | 4/15 | Klein, Arik | Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Kuo, Chih-Chun | MediaTek Inc. |
| TGbn | 4/15 | Lanante, Leonardo | Ofinno |
| TGbn | 4/15 | Lee, Hong Won | LG ELECTRONICS |
| TGbn | 4/15 | LEE, JOONSOO | Newracom Inc. |
| TGbn | 4/15 | Li, Jialing | Qualcomm Technologies Inc. |
| TGbn | 4/15 | Li, Weiyi | Spreadtrum Communication USA, Inc |
| TGbn | 4/15 | Li, Yapu | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/15 | Lim, Dong Guk | LG ELECTRONICS |
| TGbn | 4/15 | Lim, Yeon Geun | Newracom Inc. |
| TGbn | 4/15 | LIU, QINGLAI | Panasonic |
| TGbn | 4/15 | Lou, Hanqing | InterDigital, Inc. |
| TGbn | 4/15 | Lu, kaiying | MediaTek Inc. |
| TGbn | 4/15 | Lu, Liuming | Guangdong OPPO Mobile Telecommunications Corp., Ltd. |
| TGbn | 4/15 | LU, Yuxin | TCL Industries |
| TGbn | 4/15 | Luo, Chaoming | Beijing OPPO telecommunications corp., ltd. |
| TGbn | 4/15 | Ma, Yongsen | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | MAO, ZHI | Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Mehrnoush, Morteza | Apple Inc. |
| TGbn | 4/15 | Minotani, Jun | Panasonic Holdings Corporation |
| TGbn | 4/15 | Motozuka, Hiroyuki | Panasonic Holdings Corporation |
| TGbn | 4/15 | Mutgan, Okan | Nokia |
| TGbn | 4/15 | Naik, Gaurang | Qualcomm Technologies, Inc |
| TGbn | 4/15 | Nayak, Peshal | Samsung Research America |
| TGbn | 4/15 | Neishaboori, Azin | General Motors Company |
| TGbn | 4/15 | Noh, Si-Chan | Newracom Inc. |
| TGbn | 4/15 | Norouzi, Sara | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Ouchi, Masatomo | Canon |
| TGbn | 4/15 | Palayur, Saju | Maxlinear Inc |
| TGbn | 4/15 | Pare, Thomas | MediaTek Inc. |
| TGbn | 4/15 | Park, Minyoung | Intel Corporation |
| TGbn | 4/15 | Park, Sungjin | Senscomm |
| TGbn | 4/15 | Patil, Abhishek | Qualcomm Incorporated |
| TGbn | 4/15 | Patwardhan, Gaurav | Hewlett Packard Enterprise |
| TGbn | 4/15 | Petrick, Albert | InterDigital, Inc. |
| TGbn | 4/15 | Qi, Yue | Samsung Research America |
| TGbn | 4/15 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbn | 4/15 | Ratnam, Vishnu | Samsung Research America |
| TGbn | 4/15 | Roy, Rishabh | SAMSUNG ELECTRONICS |
| TGbn | 4/15 | Ryu, Kiseon | NXP Semiconductors |
| TGbn | 4/15 | Schelstraete, Sigurd | MaxLinear |
| TGbn | 4/15 | Seo, Sangho | Broadcom Corporation |
| TGbn | 4/15 | Serizawa, Kazunobu | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 4/15 | Shafin, Rubayet | Samsung Research America |
| TGbn | 4/15 | Shirakawa, Atsushi | SHARP CORPORATION |
| TGbn | 4/15 | SUH, JUNG HOON | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Sun, Bo | Sanechips Technology Co., Ltd. |
| TGbn | 4/15 | Tanaka, Yusuke | Sony Corporation |
| TGbn | 4/15 | Taori, Rakesh | Infineon Technologies |
| TGbn | 4/15 | Urabe, Yoshio | Panasonic Holdings Corporation |
| TGbn | 4/15 | Val, Inaki | MaxLinear, Inc. |
| TGbn | 4/15 | VIGER, Pascal | Canon Research Centre France |
| TGbn | 4/15 | Wang, Lei | Futurewei Technologies/Huawei Technologies |
| TGbn | 4/15 | Wang, Qi | Apple Inc. |
| TGbn | 4/15 | Wang, Xiaofei | InterDigital, Inc. |
| TGbn | 4/15 | Wang, Ying | InterDigital, Inc. |
| TGbn | 4/15 | Wee, Gaius | Panasonic Holdings Corporation |
| TGbn | 4/15 | Wei, Dong | NXP Semiconductors |
| TGbn | 4/15 | Wu, Kanke | Apple Inc. |
| TGbn | 4/15 | Wullert, John | Peraton Labs |
| TGbn | 4/15 | Xia, Qing | Sony Corporation |
| TGbn | 4/15 | Xu, Yanchao | Amlogic |
| TGbn | 4/15 | Xu, Yue | Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Yamada, Ryota | SHARP CORPORATION |
| TGbn | 4/15 | Yan, Aiguo | Ubilinx |
| TGbn | 4/15 | Yang, Jay | ZTE Corporation |
| TGbn | 4/15 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 4/15 | Yoon, Yelin | LG ELECTRONICS |
| TGbn | 4/15 | Yu, Jian | Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Yukawa, Mitsuyoshi | Canon |
| TGbn | 4/15 | Zhang, Jiayi | Ofinno |
| TGbn | 4/15 | Zhang, John | GuangDong OPPO Mobile Telecommunications Corp., Ltd. |
| TGbn | 4/15 | Zhang, Maolin | Huawei Technologies Co., Ltd |
| TGbn | 4/15 | Zhao, Yue | Huawei Technologies Co., Ltd |

* Attendee List for the 6th Conf. Call:

|  |  |  |  |
| --- | --- | --- | --- |
| Breakout | Timestamp | Name | Affiliation |
| TGbn | 4/18 | Ajami, Abdel Karim | Apple Inc. |
| TGbn | 4/18 | Asai, Yusuke | Nippon Telegraph and Telephone Corporation (NTT) |
| TGbn | 4/18 | Asterjadhi, Alfred | Qualcomm Incorporated |
| TGbn | 4/18 | Baek, SunHee | LG ELECTRONICS |
| TGbn | 4/18 | baron, stephane | Canon Research Centre France |
| TGbn | 4/18 | Baykas, Tuncer | Ofinno |
| TGbn | 4/18 | Bian, Tong | Panasonic |
| TGbn | 4/18 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Cao, Rui | NXP Semiconductors |
| TGbn | 4/18 | Carney, William | Sony Group Corporation |
| TGbn | 4/18 | Cha, Dongju | LG ELECTRONICS |
| TGbn | 4/18 | Chaturvedi, Abhishek | Samsung Electronics |
| TGbn | 4/18 | Chen, Junbin | TP-Link Corporation Limited |
| TGbn | 4/18 | Chen, You-Wei | MediaTek Inc. |
| TGbn | 4/18 | Chng, Baw | BAWMAN LLC |
| TGbn | 4/18 | Cho, Hangyu | LG ELECTRONICS |
| TGbn | 4/18 | Choi, JinHo | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Choi, Jinsoo | LG ELECTRONICS |
| TGbn | 4/18 | Chu, Liwen | NXP Semiconductors |
| TGbn | 4/18 | CHUN, JINYOUNG | LG ELECTRONICS |
| TGbn | 4/18 | Chung, Chulho | SAMSUNG |
| TGbn | 4/18 | Cui, Yaoshen | TP-Link Corporation Limited |
| TGbn | 4/18 | Di Taranto, Rocco | Ericsson AB |
| TGbn | 4/18 | Eiger, Martin | Peraton Labs |
| TGbn | 4/18 | Ekkundi, Manasi | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Erkucuk, Serhat | Ofinno |
| TGbn | 4/18 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbn | 4/18 | Fang, Juan | Intel Corporation |
| TGbn | 4/18 | Fang, Yonggang | MediaTek Inc. |
| TGbn | 4/18 | feng, Shuling | MediaTek Inc. |
| TGbn | 4/18 | Fujimori, Yuki | Canon Research Centre France |
| TGbn | 4/18 | Gao, Ning | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/18 | Ghosh, Chittabrata | Apple Inc. |
| TGbn | 4/18 | Gu, Jaheon | Samsung Electronics Co., Ltd. |
| TGbn | 4/18 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbn | 4/18 | Gupta, Binita | Cisco Systems, Inc. |
| TGbn | 4/18 | Ha, Taeyoung | Samsung Electronics Co., Ltd. |
| TGbn | 4/18 | Haider, Muhammad Kumail | Meta Platforms, Inc. |
| TGbn | 4/18 | Handte, Thomas | Sony Group Corporation |
| TGbn | 4/18 | Hart, Brian | Cisco Systems, Inc. |
| TGbn | 4/18 | Hasabelnaby, Mahmoud | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Helwa, Sherief | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/18 | Hervieu, Lili | CableLabs |
| TGbn | 4/18 | Hsu, Yung Lin | National Taiwan University |
| TGbn | 4/18 | Hu, Chunyu | Spreadtrum Communications US |
| TGbn | 4/18 | HUANG, CHIHAN | MediaTek Inc. |
| TGbn | 4/18 | Huang, Po-Kai | Intel Corporation |
| TGbn | 4/18 | Inohiza, Hirohiko | Canon |
| TGbn | 4/18 | Jang, Insun | LG ELECTRONICS |
| TGbn | 4/18 | Jee, Anand | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Jeon, Eunsung | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Kalamkar, Sanket | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/18 | kamath, Manoj | Broadcom Corporation |
| TGbn | 4/18 | Kamel, Mahmoud | Interdigital Inc. |
| TGbn | 4/18 | Kandala, Srinivas | Samsung |
| TGbn | 4/18 | Karthik, S. G. | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Kim, Geon Hwan | LG ELECTRONICS |
| TGbn | 4/18 | Kim, Jeongki | Ofinno |
| TGbn | 4/18 | Kim, Sang Gook | LG ELECTRONICS |
| TGbn | 4/18 | Kim, Sanghyun | WILUS Inc. |
| TGbn | 4/18 | Kim, Youhan | Qualcomm Technologies, Inc. |
| TGbn | 4/18 | Kishida, Akira | NTT |
| TGbn | 4/18 | Klein, Arik | Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Koo, Jonghoe | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Kuo, Chih-Chun | MediaTek Inc. |
| TGbn | 4/18 | Lanante, Leonardo | Ofinno |
| TGbn | 4/18 | Lee, Hong Won | LG ELECTRONICS |
| TGbn | 4/18 | LEE, JOONSOO | Newracom Inc. |
| TGbn | 4/18 | LEE, Mingyu | Samsung Electronics Co., Ltd. |
| TGbn | 4/18 | Lee, Wookbong | Apple Inc. |
| TGbn | 4/18 | Li, Haozheng | TP-Link Corporation Limited |
| TGbn | 4/18 | Li, Jialing | Qualcomm Technologies Inc. |
| TGbn | 4/18 | Li, Weiyi | Spreadtrum Communication USA, Inc |
| TGbn | 4/18 | Li, Yapu | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/18 | Lim, Dong Guk | LG ELECTRONICS |
| TGbn | 4/18 | Lim, Yeon Geun | Newracom Inc. |
| TGbn | 4/18 | LIU, QINGLAI | Panasonic |
| TGbn | 4/18 | Lorgeoux, Mikael | Canon Research Centre France |
| TGbn | 4/18 | Lou, Hanqing | InterDigital, Inc. |
| TGbn | 4/18 | Lu, kaiying | MediaTek Inc. |
| TGbn | 4/18 | Lu, Liuming | Guangdong OPPO Mobile Telecommunications Corp., Ltd. |
| TGbn | 4/18 | LU, Yuxin | TCL Industries |
| TGbn | 4/18 | Ma, Yongsen | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | McCann, Stephen | Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Minotani, Jun | Panasonic Holdings Corporation |
| TGbn | 4/18 | Motozuka, Hiroyuki | Panasonic Holdings Corporation |
| TGbn | 4/18 | Nayak, Peshal | Samsung Research America |
| TGbn | 4/18 | Neishaboori, Azin | General Motors Company |
| TGbn | 4/18 | Ng, Boon Loong | Samsung Research America |
| TGbn | 4/18 | Noh, Si-Chan | Newracom Inc. |
| TGbn | 4/18 | Norouzi, Sara | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Palayur, Saju | Maxlinear Inc |
| TGbn | 4/18 | Park, Sungjin | Senscomm |
| TGbn | 4/18 | Patil, Abhishek | Qualcomm Incorporated |
| TGbn | 4/18 | Patwardhan, Gaurav | Hewlett Packard Enterprise |
| TGbn | 4/18 | Petrick, Albert | InterDigital, Inc. |
| TGbn | 4/18 | Qi, Yue | Samsung Research America |
| TGbn | 4/18 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbn | 4/18 | Ratnam, Vishnu | Samsung Research America |
| TGbn | 4/18 | RISON, Mark | Samsung Cambridge Solution Centre |
| TGbn | 4/18 | Rosenzweig Arbel, Gil | Renesas Electronics Corporation |
| TGbn | 4/18 | Roy, Rishabh | SAMSUNG ELECTRONICS |
| TGbn | 4/18 | Ryu, Kiseon | NXP Semiconductors |
| TGbn | 4/18 | Sadiq, Bilal | Samsung Research America |
| TGbn | 4/18 | Sato, Takuhiro | SHARP CORPORATION |
| TGbn | 4/18 | Schelstraete, Sigurd | MaxLinear |
| TGbn | 4/18 | Serizawa, Kazunobu | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 4/18 | Shafin, Rubayet | Samsung Research America |
| TGbn | 4/18 | Shilo, Shimi | Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Song, Hao | Intel Corporation |
| TGbn | 4/18 | Strobel, Rainer | Maxlinear |
| TGbn | 4/18 | SUH, JUNG HOON | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Sun, Bo | Sanechips Technology Co., Ltd. |
| TGbn | 4/18 | Talarico, Salvatore | Sony Corporation |
| TGbn | 4/18 | Taori, Rakesh | Infineon Technologies |
| TGbn | 4/18 | Tota, Kazuyuki | Canon |
| TGbn | 4/18 | Tsujimaru, Yuki | Canon |
| TGbn | 4/18 | Urabe, Yoshio | Panasonic Holdings Corporation |
| TGbn | 4/18 | VIGER, Pascal | Canon Research Centre France |
| TGbn | 4/18 | Wang, Lei | Futurewei Technologies/Huawei Technologies |
| TGbn | 4/18 | Wang, Qi | Apple Inc. |
| TGbn | 4/18 | Wang, Ying | InterDigital, Inc. |
| TGbn | 4/18 | Wee, Gaius | Panasonic Holdings Corporation |
| TGbn | 4/18 | Wei, Dong | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/18 | Wilhelmsson, Leif | Ericsson AB |
| TGbn | 4/18 | Wu, Tianyu | Apple Inc. |
| TGbn | 4/18 | Wullert, John | Peraton Labs |
| TGbn | 4/18 | Xia, Qing | Sony Corporation |
| TGbn | 4/18 | Xu, Yanchao | Amlogic |
| TGbn | 4/18 | Xu, Yue | Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Yan, Aiguo | Ubilinx |
| TGbn | 4/18 | Yang, Jay | ZTE Corporation |
| TGbn | 4/18 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 4/18 | Yee, James | MediaTek Inc. |
| TGbn | 4/18 | Yoon, Yelin | LG ELECTRONICS |
| TGbn | 4/18 | Yu, Jian | Huawei Technologies Co., Ltd |
| TGbn | 4/18 | Zhang, Jiayi | Ofinno |
| TGbn | 4/18 | Zhao, Yue | Huawei Technologies Co., Ltd |

* Attendee List for the 8th Conf. Call:

|  |  |  |  |
| --- | --- | --- | --- |
| Breakout | Timestamp | Name | Affiliation |
| TGbn | 4/29 | Abouelseoud, Mohamed | Apple Inc. |
| TGbn | 4/29 | Aio, Kosuke | Sony Corporation |
| TGbn | 4/29 | Ajami, Abdel Karim | Apple Inc. |
| TGbn | 4/29 | Anwyl, Gary | Mediatek Inc |
| TGbn | 4/29 | Asai, Yusuke | Nippon Telegraph and Telephone Corporation (NTT) |
| TGbn | 4/29 | Asterjadhi, Alfred | Qualcomm Incorporated |
| TGbn | 4/29 | Baek, SunHee | LG ELECTRONICS |
| TGbn | 4/29 | Baykas, Tuncer | Ofinno |
| TGbn | 4/29 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbn | 4/29 | Carney, William | Sony Group Corporation |
| TGbn | 4/29 | Cha, Dongju | LG ELECTRONICS |
| TGbn | 4/29 | Chaturvedi, Abhishek | Samsung Electronics |
| TGbn | 4/29 | Chen, You-Wei | MediaTek Inc. |
| TGbn | 4/29 | CHENG, yajun | Xiaomi Communications Co., Ltd. |
| TGbn | 4/29 | Chisci, Giovanni | Qualcomm Technologies, Inc |
| TGbn | 4/29 | Cho, Hangyu | LG ELECTRONICS |
| TGbn | 4/29 | Choi, Jinsoo | LG ELECTRONICS |
| TGbn | 4/29 | Chu, Liwen | NXP Semiconductors |
| TGbn | 4/29 | CHUN, JINYOUNG | LG ELECTRONICS |
| TGbn | 4/29 | Coffey, John | Realtek Semiconductor Corp. |
| TGbn | 4/29 | Erkucuk, Serhat | Ofinno |
| TGbn | 4/29 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbn | 4/29 | Fang, Juan | Intel Corporation |
| TGbn | 4/29 | Fang, Yonggang | MediaTek Inc. |
| TGbn | 4/29 | Gao, Ning | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/29 | Ghosh, Chittabrata | Apple Inc. |
| TGbn | 4/29 | Gu, Jaheon | Samsung Electronics Co., Ltd. |
| TGbn | 4/29 | Gu, Junrong | Clourney Semiconductor |
| TGbn | 4/29 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbn | 4/29 | Gupta, Binita | Cisco Systems, Inc. |
| TGbn | 4/29 | Hamilton, Mark | CommScope |
| TGbn | 4/29 | Hart, Brian | Cisco Systems, Inc. |
| TGbn | 4/29 | Hasabelnaby, Mahmoud | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Hedayat, Ahmadreza | Apple Inc. |
| TGbn | 4/29 | Hervieu, Lili | CableLabs |
| TGbn | 4/29 | Hosseinianfar, Hamid | Ofinno |
| TGbn | 4/29 | Hsu, Yung Lin | National Taiwan University |
| TGbn | 4/29 | Hu, Chunyu | Spreadtrum Communications US |
| TGbn | 4/29 | Huang, Po-Kai | Intel Corporation |
| TGbn | 4/29 | Jang, Insun | LG ELECTRONICS |
| TGbn | 4/29 | Jee, Anand | SAMSUNG ELECTRONICS |
| TGbn | 4/29 | Jeon, Eunsung | SAMSUNG ELECTRONICS |
| TGbn | 4/29 | Kain, Carl | USDOT; Noblis |
| TGbn | 4/29 | Kalamkar, Sanket | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/29 | Kamel, Mahmoud | Interdigital Inc. |
| TGbn | 4/29 | Kandala, Srinivas | Samsung |
| TGbn | 4/29 | Kim, Sang Gook | LG ELECTRONICS |
| TGbn | 4/29 | Kim, Youhan | Qualcomm Technologies, Inc. |
| TGbn | 4/29 | Kishida, Akira | NTT |
| TGbn | 4/29 | Klein, Arik | Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Kuo, Chih-Chun | MediaTek Inc. |
| TGbn | 4/29 | Lanante, Leonardo | Ofinno |
| TGbn | 4/29 | Lee, Gwangho | Korea National University of Transportation |
| TGbn | 4/29 | Lee, Hong Won | LG ELECTRONICS |
| TGbn | 4/29 | LEE, JOONSOO | Newracom Inc. |
| TGbn | 4/29 | Levy, Joseph | InterDigital, Inc. |
| TGbn | 4/29 | Li, Jialing | Qualcomm Technologies Inc. |
| TGbn | 4/29 | Li, Weiyi | Spreadtrum Communication USA, Inc |
| TGbn | 4/29 | Li, Yapu | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/29 | Lim, Dong Guk | LG ELECTRONICS |
| TGbn | 4/29 | Lim, Yeon Geun | Newracom Inc. |
| TGbn | 4/29 | LIU, QINGLAI | Panasonic |
| TGbn | 4/29 | Lou, Hanqing | InterDigital, Inc. |
| TGbn | 4/29 | Lu, kaiying | MediaTek Inc. |
| TGbn | 4/29 | Lu, Liuming | Guangdong OPPO Mobile Telecommunications Corp., Ltd. |
| TGbn | 4/29 | LU, Yuxin | TCL Industries |
| TGbn | 4/29 | Luo, Chaoming | Beijing OPPO telecommunications corp., ltd. |
| TGbn | 4/29 | Ma, Yongsen | SAMSUNG ELECTRONICS |
| TGbn | 4/29 | Mehrnoush, Morteza | Apple Inc. |
| TGbn | 4/29 | Nezou, Patrice | Canon Research Centre France |
| TGbn | 4/29 | Norouzi, Sara | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Nurani Krishnan, Neelakantan | Apple Inc. |
| TGbn | 4/29 | Ouchi, Masatomo | Canon |
| TGbn | 4/29 | Park, Minyoung | Intel Corporation |
| TGbn | 4/29 | Park, Sungjin | Senscomm |
| TGbn | 4/29 | Patil, Abhishek | Qualcomm Incorporated |
| TGbn | 4/29 | Patwardhan, Gaurav | Hewlett Packard Enterprise |
| TGbn | 4/29 | Petrick, Albert | InterDigital, Inc. |
| TGbn | 4/29 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbn | 4/29 | Ratnam, Vishnu | Samsung Research America |
| TGbn | 4/29 | Roy, Rishabh | SAMSUNG ELECTRONICS |
| TGbn | 4/29 | Ryu, Kiseon | NXP Semiconductors |
| TGbn | 4/29 | Sadiq, Bilal | Samsung Research America |
| TGbn | 4/29 | Schelstraete, Sigurd | MaxLinear |
| TGbn | 4/29 | Serizawa, Kazunobu | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 4/29 | Shafin, Rubayet | Samsung Research America |
| TGbn | 4/29 | Singh, Aditi | Charter Communications |
| TGbn | 4/29 | Song, Hao | Intel Corporation |
| TGbn | 4/29 | SUH, JUNG HOON | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Sun, Bo | Sanechips Technology Co., Ltd. |
| TGbn | 4/29 | Talarico, Salvatore | Sony Corporation |
| TGbn | 4/29 | Taori, Rakesh | Infineon Technologies |
| TGbn | 4/29 | Vaidya, Maulik | Charter Communications |
| TGbn | 4/29 | Vermani, Sameer | Qualcomm Incorporated; Qualcomm Technologies, Inc |
| TGbn | 4/29 | Wang, Lei | Futurewei Technologies/Huawei Technologies |
| TGbn | 4/29 | Wang, Qi | Apple Inc. |
| TGbn | 4/29 | Wang, Xiaofei | InterDigital, Inc. |
| TGbn | 4/29 | Wang, Ying | InterDigital, Inc. |
| TGbn | 4/29 | Wei, Dong | Guangdong OPPO Mobile Telecommunications Corp., Ltd |
| TGbn | 4/29 | Wu, Chao-Yi | Samsung Electronics Co., Ltd. |
| TGbn | 4/29 | Wu, Tianyu | Apple Inc. |
| TGbn | 4/29 | Wullert, John | Peraton Labs |
| TGbn | 4/29 | Xia, Qing | Sony Corporation |
| TGbn | 4/29 | Xiao, Tong | Xiaomi Communications Co., Ltd. |
| TGbn | 4/29 | Xu, Yanchao | Amlogic |
| TGbn | 4/29 | Xu, Yue | Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Yan, Aiguo | Ubilinx |
| TGbn | 4/29 | Yan, Zhongjiang | Northwestern Polytechnical University |
| TGbn | 4/29 | Yang, Jimmy | Moxa Inc. |
| TGbn | 4/29 | YANG, RUI | InterDigital, Inc. |
| TGbn | 4/29 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbn | 4/29 | Yee, James | MediaTek Inc. |
| TGbn | 4/29 | Yoon, Yelin | LG ELECTRONICS |
| TGbn | 4/29 | Yu, Jian | Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Zhang, Jiayi | Ofinno |
| TGbn | 4/29 | Zhang, Maolin | Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Zhang, Yan | Apple Inc. |
| TGbn | 4/29 | Zhao, Yue | Huawei Technologies Co., Ltd |
| TGbn | 4/29 | Zhou, Lei | H3C Technologies Co., Limited |
| TGbn | 4/29 | Zhou, Pei | TCL |