IEEE P802.11
Wireless LANs

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| Minutes 802.11 bn PHY ad hoc – Montreal F2F July 2024  |
| Date: 18 July 2024 |
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Abstract

This document contains the PHY ad hoc meeting minutes for sessions held during the July 802.11 plenary session in Montreal:

* Monday July 15th, 2024, AM1
* Monday July 15th, 2024, PM2
* Tuesday July 16th, 2024, PM1
* Wednesday July 17th, AM1
* Wednesday July 17th, AM2
* Wednesday July 17th, PM2
* Thursday July 18th, AM1
* Thursday July 18th, AM2

# Monday July 15th, 2024, AM1

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 8:00am ET.
2. The Chair follows the agenda in IEEE 802.11-24/0976r2.
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
4. The Chair goes through the Copyright policy.
5. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
6. Discussions on the agenda. **UEQM + MAP**
	* [24/0890](https://mentor.ieee.org/802.11/dcn/24/11-24-0890-00-00bn-unequal-pattern-discussion.pptx) Unequal pattern discussion Ross Jian Yu
	* [24/1132](https://mentor.ieee.org/802.11/dcn/24/11-24-1132-00-00bn-frequency-domain-ueqm.pptx) Frequency Domain UEQM Mengshi Hu
	* [24/1186](https://mentor.ieee.org/802.11/dcn/24/11-24-1186-00-00bn-new-mcss-for-11bn-follow-up.pptx) New MCSs for 11bn-Follow Up Shengquan Hu
	* [24/1216](https://mentor.ieee.org/802.11/dcn/24/11-24-1216-01-00bn-htc-extension-for-uhr-link-adaptation-to-support-ueq-mcs-or-ueqm.pptx) HTC Ext.n for UHR LA to Support UEQ-MCS or UEQM Sara Norouzi
	* [24/0488](https://mentor.ieee.org/802.11/dcn/24/11-24-0488-01-00bn-sta-assisted-calibration-for-multi-ap-coordination.pptx) STA-assisted Calibration for Multi-AP Coordination Ke Zhong
	* [24/1204](https://mentor.ieee.org/802.11/dcn/24/11-24-1204-00-00bn-coordinated-beamforming-for-11bn.pptx) Coordinated Beamforming for 11bn Insik Jung
	* [24/1211](https://mentor.ieee.org/802.11/dcn/24/11-24-1211-00-00bn-coordinated-bf-goodput-discussion.pptx) Coordinated BF Goodput Discussion Genadiy Tsodik

**Technical contributions**

**24/0890r1 Unequal pattern discussion (Ross Jian Yu, presented by Shimi Shilo)**

Discussions on UEQM gain/pattern selection and provide simulation results.

No SPs

Q&A

No questions.

**24/1132r0 Frequency Domain UEQM (Mengshi Hu)**

Propose frequency domain UEQM, divide MRU to different RUs or divide a RU to 2 parts to apply different modulations.

Deferred due to Audio issue.

Q&A

N/A

**24/1186r0 New MCSs for 11bn-Follow Up (Shenquan Hu)**

Summary on proposals on new MCSs and run SPs on new MCSs.

Q&A

Q: Request to defer the SP for further discussions.

SPs will be harmonized offline before running them. Will revisit this contribution later.

**24/1132r0 Frequency Domain UEQM (Mengshi Hu)**

Propose frequency domain UEQM.

Continue presentation. No SPs.

Q&A

Q: Do you have simulation results to support your proposal?

A: Reference 2 has some results. This is similar to reference 2.

Q: Interference can be on and off, how can transmitter know whether receiver will experiencing interference?

A: This is related to implementation. For some cases, some sub channels are busier than other subchannels. You can also do sounding to know interference situation.

Q: Do you want this feature in SU or also in OFDMA? In OFDMA, it seems not needed.

Q: It may degrade the performance if interference cannot be predicted by Tx side. Also depends on granularity of interference.

A: Whether interference is dynamic or not depends on cases. There are static cases of interference.

Q: We can do puncturing if there is static interference on 20MHz sub channel. So I don’t understand the use case for freq UEQM.

A: In reference 2, it shows UEQM is better than puncturing. We can provide some simulation to show the difference.

Q: You mentioned MRU split and single RU split. Do you propose both or one of them?

A: It’s more reasonable to support RU division than MRU division. But I am open.

Q: You show the case with 3 modulations. Is this design an overkill? Need to think about the design complexity.

A: This is just an example. Will provide simulation results.

Q: Is it joint coding or independent coding?

A: Both are fine to us.

Q: Will you combine this with spatial domain UEQM?

A: No for the sake of complexity.

Q: Do you have limitations on RU size to divide the RU for UEQM?

A: Larger RU will be more efficient.

Q: Do you consider hybrid mode that some RU use frequency domain UEQM and some RU use spatial domain UEQM? Or some RU use freq domain UEQM and other RU use EQM?

A: I think this can be supported.

**24/1216r1 HTC Extension for UHR Link Adaptation to Support UEQ-MCS or UEQM (Sara Norouzi)**

Propose to extend the HT control field to accommodate the link adaptation parameters for the UHR UEQ-MCS/UEQM.

No SP.

Q&A

Q: How do you decide the UEQM pattern at receiver side?

A: This is up to implementation. For Example, based on SINR difference on spatial streams.

Q: There need to be some method to show that there is a metric to get this UEQM pattern.

Q: How often do you expect this feedback to be transmitted.

A: It depends on this is solicited or unsolicited feedback.

Q: How many ms in your mind?

A: I don’t have a number now, we can discuss offline.

A: Theoretically, we can feedback in any data and management frame.

Q: The proposed feedback is carried in data and management frame. What if there is no traffic in the feedback link. For example, only have DL frame no UL traffic, how to feedback in UL?

A: We need HTC feedback for link adaptation.

Q: If AGC is different package by package. It can be different for sounding and data package. How to determine MCS with different AGC?

A: AGC does not change the SINR. MCS only depends on SINR.

**24/0488r1 STA-assisted Calibration for Multi-AP Coordination (Ke Zhong)**

Propose STA-assisted synchronization and calibration for multi-AP coordination. Details needs further study, including measurements, signaling, procedure etc.

No SP.

Q&A

Q: If STAs are from different vendors, measurement and report could be different. How can AP understand the report from different STA?

A: We only consider one STA now.

Q: There are issues such as reliability, availability, assurance etc and we can’t rely on STA assisted calibration.

A: This is useful when we don’t have good enough infrastructure such as backhaul.

Q: May need more details and simulations to help make decision.

A: Agree.

Q: What does the non-ideal backhaul mean?

A: AP can hear each other but backhaul between APs are non-ideal.

**Recess**

The meeting is recessed at 10:00 am ET.

# Monday July 15th, 2024, PM2

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 4:00pm ET.
2. The Chair follows the agenda in IEEE 802.11-24/0976r4.
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
4. The Chair goes through the Copyright policy.
5. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
6. Discussions on the agenda. **DRU—part 1**
	* [24/0736](https://mentor.ieee.org/802.11/dcn/24/11-24-0736-01-00bn-preamble-and-pe-transmission-in-ppdu-using-dru.pptx) Preamble and PE transmission in PPDU using DRU Yapu Li
	* [24/0986](https://mentor.ieee.org/802.11/dcn/24/11-24-0986-00-00bn-further-considerations-for-dru-design.pptx) Further Considerations for DRU Design Hamid Hosseinianfar
	* [24/1096](https://mentor.ieee.org/802.11/dcn/24/11-24-1096-00-00bn-mirror-symmetric-20-mhz-dru-tone-plan-within-242-rru-boundary.pptx) Mirror Symmetric 20 MHz DRU Tone Plan within 242 RRU Boundary Eunsung Park
	* [24/1097](https://mentor.ieee.org/802.11/dcn/24/11-24-1097-00-00bn-thoughts-on-uhr-ltf-for-dru.pptx) Thoughts on UHR-LTF for DRU Eunsung Park
	* [24/1114](https://mentor.ieee.org/802.11/dcn/24/11-24-1114-00-00bn-uhr-ltf-design-for-dru.pptx) UHR-LTF Design for DRU Mahmoud Kamel

**Technical contributions**

**24/0736r1 Preamble and PE transmission in PPDU using DRU (Yapu Li)**

A few SPs for DRU

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

* If a DRU for a PPDU occupies more than one 20 MHz channel, then the L-STF, L-LTF, L-SIG, and RL-SIG fields are duplicated over all the 20 MHz channels which are occupied by the DRU.

Y/N/A: 75%/ 3% /22% total 68 votes. Results by votes: 51/2/15.

Q&A

Q: Some clarification questions.

Q: Duplicate means we keep same phase rotation?

A: Yes.

Q: Why skip U-SIG in preamble in this SP?

A: U-SIG is in our SP2. It may not be same for legacy preamble for U-SIG part.

**SP2: Do you agree to add the following text to the TGbn SFD?**

* If a DRU for a PPDU occupies more than one 20 MHz channel, then the SIG field is duplicated over all the 20 MHz channels within a given 80MHz frequency subblock which are occupied by the DRU.
	+ ~~The content of SIG field between different 80MHz frequency subblocks is TBD.~~

Note: The SIG field is U-SIG in a UHR TB PPDU

Q&A

Q: Why can’t this SP combine with SP1? Why is this limited to within 80?

A: Depends on design which is not determined yet.

Q: In 11be we didn’t not mandate the U-SIG content to be same at the beginning. Later we didn’t find the need then becomes same content. For UHR we are not sure for now. Better to leave it open.

Q: I believe it is more reasonable to be the opposite way. We make the content different only when we found the need.

A: Suggest adding a second note saying content TBD.

Q: Suggest deferring this SP as there are ongoing discussions and DRU may not extend more than 80MHz. Or remove “The content of SIG field between different 80MHz frequency subblocks is TBD.” from the SP.

A: Ok to defer this SP.

SP2 deferred.

**SP3: Do you agree to add the following text to the TGbn SFD?**

* The set of tones used by the PE field should be same as the set of tones in the DRU used by the Data field.

Q&A

Q: Request to defer this SP.

Q: Only have requirement on the spectrum but may not need to have same tone set. Need to check.

A: Ok to defer this SP.

**24/0986r0 Further Considerations for DRU Design (Hamid Hosseinianfar)**

Propose to disable some tones in DRU to further boost the power.

No SP.

Q&A

Q: Have you checked performance in terms of throughput?

A: If you use less tones, you will get lower throughput. It’s a tradeoff. We can support more STAs.

Q: Comparing to repetition, what is the performance difference? Want to see some simulations to show the gain.

A: Will provide some simulation results.

Q: If you use half of the data tones, do you also want to cut the pilot tones? That will be only 1 pilot tone and not sufficient.

A: Agree 1 pilot tone does not work.

**24/1096r0 Mirror Symmetric 20MHz DRU Tone Plan within 242 RRU Boundary (Eunsung Park)**

Propose a new 20 MHz DRU tone plan which is mirror symmetric for both data and pilot tones and guarantees 242 RRU boundary.

No SPs.

Q&A

Q: With big tone plan change may lead to other problem such as smoothing gain. Minor tone plan change is preferred.

A: Don’t agree smoothing gain will be affected. The processing is the same.

Q: Also don’t see benefit of mirror symmetric.

A: Depends on implementation. Some implementations may be able to make use of this tone plan.

Q: The tone plan can be tweaked in many ways. I didn’t see the reason to tweak the tone plan if we can’t find the real gain/benefit for it.

A: We have revised our tone plan with respect to some of your concerns.

Q: Mirror symmetric tone plan follows tradition and may simplify implementation.

Q: The other design of tone plan reuse mostly of old tone plan and is more friendly to implementation.

**24/1097r0 Thoughts on UHR-LTF for DRU (Eunsung Park)**

Discussed UHR-LTF design for DRU and how to transmit UHR-LTF in a PPDU using DRUs.

No SPs.

Q&A

Q: Seem you suggest keeping same number of streams for DRU? Have you considered the performance with ICI and other impairments? Is it practical to support 4 or 8 SSs for DRU?

A: We need to evaluate the performance.

Q: It seems a bit too early to have this UHR-LTF design without a tone plan design.

A: Agree this is premature.

**24/1114r0 UHR-LTF Design for DRU (Mahmoud Kamel)**

The contribution proposed two different methods for the selection of the LTF sequence for DRU. Also showed some results for the PAPR performance of the UHR-LTF for DRU and provide preference on the methods.

No SP.

Q&A

Q: Channel estimation accuracy is important. Suggest using the new 4xLTF with new sequence.

A: The performance depends on Channel. Can have further discussion.

Q: Is it possible to design a sequence to be good for both DRU and RRUs?

A: That’s why we prefer method 2 which reuses RRU sequence.

Q: But they are in different tones. What about using same sequence on same tones?

Q: Request to defer the SP.

A: Ok to defer the SP.

Q: Value 0 in LTF sequence are for the unused tone right?

A: Correct.

**Adjourn**

The meeting is adjourned for Monday at 6:00 pm ET.

# Tuesday July 16th, 2024, PM1

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 1:30pm ET.
2. The Chair follows the agenda in IEEE 802.11-24/0976r5.
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
4. The Chair goes through the Copyright policy.
5. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
6. Discussions on the agenda. **DRU – Part 2**
	* [24/1130](https://mentor.ieee.org/802.11/dcn/24/11-24-1130-00-00bn-distribution-bandwidth-of-dru-follow-up.pptx) Distribution Bandwidth of DRU - Follow up Mengshi Hu
	* [24/1131](https://mentor.ieee.org/802.11/dcn/24/11-24-1131-00-00bn-dru-for-puncturing-case-1001.pptx) DRU for Puncturing Case 1001 Mengshi Hu
	* [24/1173](https://mentor.ieee.org/802.11/dcn/24/11-24-1173-00-00bn-enabling-20mhz-operating-stas-in-80mhz-dru-transmissions.pptx) Enabling 20MHz Operating STAs in 80MHz DRU Transmissions

Chenchen LIU

* + [24/1174](https://mentor.ieee.org/802.11/dcn/24/11-24-1174-00-00bn-enhanced-dru-utilization-in-40mhz-and-80mhz-distributed-bandwidth.pptx) Enhanced DRU Utilization in 40MHz and 80MHz Distributed Bandwidth Chenchen LIU
	+ [24/1187](https://mentor.ieee.org/802.11/dcn/24/11-24-1187-00-00bn-dru-tone-plan-for-11bn-follow-up.pptx) DRU Tone Plan for 11bn-Follow Up Shengquan Hu

**Technical contributions**

**24/1130r1 Distribution Bandwidth of DRU – Follow up (Mengshi Hu)**

Propose to support 20, 40, 80 and 160MHz bandwidth for DRU and use common indication for DRU bandwidth.

No SPs.

Q&A

Q: Some clarification questions in signaling.

Q: If we have 320MHz bandwidth, how many bits are needed in signaling for each 80MHz?

A: 2-3 bits.

Q: In each 80MHz, we have quite some tone plans now. Seems this signaling is quite complicated with the tone plans.

A: Regarding tone plans, the signaling is similar.

Q: Using 160MHz bandwidth to send 106 tone DRU seems waste a large BW and looks like UWB. 160MHz DRU seems a step too far.

Q: I am supportive to this direction with the DRU modes for different cases to improve the efficiency.

Q: For trigger, the proposed signaling need to base on RU index to find my DRU bandwidth, then to find out RU index. The two steps make it more complex for STA to figure out the allocated RU. Why we need so many DRU modes which increases the complexity?

A: Offline discussion due to some audio issue.

Q: Clarification on SP time. As signaling is the last piece of design for this feature. Prefer to defer the SP, not in this week.

A: Ok with it.

**24/1131r0 DRU for Puncturing Case 1001 (Mengshi Hu)**

Propose to define aggregated 40MHz DRU bandwidth for the puncturing case 1001.

No SPs.

Q&A

Q: 20MHz only STA will not be supported?

A: Similar to 0011 or 1100 case.

Q: What about PAPR performance for this case?

A: Need to evaluate.

Q: When we define MRU, we have lots of debate on the patterns. In the field, we see limited patterns are useful. We are adding this pattern to make more complete set but may not see real benefit.

Q: Not clear what is the benefit of introduce this mode. Brings lots of complexity.

A: I think the only complexity is the signaling.

Q: If you bring design for 1001, why not also define 0110?

A: 1001 is allowed in 11be, but 0110 is not.

Q: You are introducing MRU 40MHz, where we didn’t even have MRU 40 for RRU case. For DRU, we are not even defining for 40+20, there is no reason to define for 20+20 DRU.

A: We think there is no complexity to define this mode at all.

**24/1173r0 Enabling 20MHz Operating STAs in 80MHz DRU Transmissions (Chenchen Liu)**

Propose to subdivide 106 tone DRUs into four 26-tone DRUs within an 80MHz bandwidth to enable 20MHz operating STAs to participate in 80MHz DRU transmission.

No SPs.

Q&A

Q: It is not making spectrum more efficient, maybe opposite. How many 20MHz only devices will operate in the 80MHz BW? If only 1-2, the rest part of the spectrum will be wasted. Also have complexity concerns.

A: There is not much complexity since all the parts are already there.

**24/1174r0 Enhanced DRU Utilization in 40MHz and 80MHz Distributed Bandwidth (Chenchen Liu)**

Propose to define extra DRUs for 40 and 80MHz bandwidth to improve spectrum efficiency.

No SPs.

Q&A

Q: In favor of the direction especially for 40MHz case. For 80MHz case, need details on tone plan and have some further discussions.

A: Agree need to have more discussions for 80MHz case.

Q: I don’t see much benefit for the price of modify the 52 tone RU table. I don’t see necessary to define different number of 52tone RUs for RRU and DRU cases.

A: We can get extra 1 DRU for 40MHz case and 2 DRU for 80MHz case for free.

Q: How much chance can use these DRUs? If you don’t have the chance to use the “free” DRU, there is not much benefit.

A: RUs are already there, so no extra complexity and we have nothing to lose to get these free DRUs.

**24/1187r0 DRU Tone Plan for 11bn-Follow Up (Shenquan Hu)**

Provide analysis and comparison of different DRU tone plans discussed in the group.

No SP.

Q&A

Q: For 20MHz tone plan, you mentioned option 2 will introduce new pattern. But I think they have same pattern with just tone shift.

A: If you do channel smoothing, the processing is different. This brings unnecessary complexity.

Q: I don’t get where the complexity is.

Q: For the 80MHz case, the other proposed tone plan, the PAPR performance is better.

Q: Some clarification questions.

Q: You mentioned the smoothing pattern is different for 4-3-4-3 design. Your DRU52 and DRU106 is also different. I don’t think this proposed tone is better than the other proposed tone plan.

A: In my design it is repeatable, which makes the smoothing easier.

**Adjourn**

The meeting is adjourned for Tuesday at 3:30 pm ET.

# Wednesday July 17th, 2024, AM1

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 8:00am ET.
2. The Chair follows the agenda in IEEE 802.11-24/0976r6.
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
4. The Chair goes through the Copyright policy.
5. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
6. Discussions on the agenda. **DRU – Part 3**
	* [24/1188](https://mentor.ieee.org/802.11/dcn/24/11-24-1188-00-00bn-global-csd-index-assignment-for-dru-stf-transmission-in-11bn.pptx) Global CSD Index Assignment for DRU STF Transmission in 11bn

Shengquan Hu

* + [24/1172](https://mentor.ieee.org/802.11/dcn/24/11-24-1172-00-00bn-csd-indication-design.pptx) CSD Indication Design\* Bo Gong
	+ [24/1189](https://mentor.ieee.org/802.11/dcn/24/11-24-1189-00-00bn-dru-transmission-on-frequency-subblocks-of-wide-bandwidth-ppdu.pptx) DRU TX on Frequency Subblocks of Wide Bandwidth PPDU Shengquan Hu
	+ 24/1230 pilot-tone-design-in-dRU-transmission Lin Yang
	+ [24/1231](https://mentor.ieee.org/802.11/dcn/24/11-24-1231-00-00bn-uhr-ltfs-for-dru-and-sounding-operation.pptx) UHR LTFs for DRU and Sounding Operation Leonardo Lanante
	+ [24/1245](https://mentor.ieee.org/802.11/dcn/24/11-24-1245-00-00bn-tone-distribution-in-dru-with-preamble-puncturing.pptx) Tone distribution in DRU with preamble puncturing Yan Xin

**Technical contributions**

**24/1188r1 Global CSD Index Assignment for DRU STF Transmission in 11bn (Shengquan Hu)**

Proposed a DRU index based global CSD Index assignment method to minimize collision, achieve good power measurement performance and without extra signaling requirement.

No SPs.

Q&A

Q: Some clarifications on an earlier contribution. Some comments on simulation configurations. Commenter think some assumptions in the simulation is questionable.

A: Don’t agree with the commenter on the assumptions. Explained the settings. Need more offline discussions.

Q: Prefer CSD with signaling.

A: If do signaling based, which is per user signaling. Need 3 bits signaling for 8 values for each user. Too much overhead. And from performance point of view, it is unnecessary. Not benefit from signaling based method.

Q: Slide 6: Seems this signaling has some waste. Also, if we have multiple spatial streams on a DRU, not sure how to signal.

A: Want to keep same signaling as RRU. For multiple ss case, there are some other contribution already have discussion on it. It follows some rules. For example ss1 signals CSD value 1, ss2 will use CSD value 2.

**24/1172r1 CSD Indication Design (Bo Gong)**

Defer the presentation due to network issue.

**24/1189r1 DRU TX on Frequency Subblocks of Wide Bandwidth PPDU (Shengquan Hu)**

Propose DRU transmission on frequency subblocks of wide BW PPDU that the DRU subcarriers on a frequency subblock can be simply generated by a constant shift on DRU tone plan designed for 20,40 and 80MHz distribution BW.

No SPs.

Q&A

Q: Request to defer the SP. Have similar proposal will bring next time.

A: Sure.

Q: Slide 9, suggest to slightly modify the values in the table.

A: Still want to keep the value. This is a simple lookup table. This proposed value is following slide 5. We can have more discussions.

Q: We share similar idea on tone shifting. I also have contributions following. We can have further discussion. One suggestion: in 11be, we use 20Mhz sub channel and 80MHz subblock. Prefer to align the terminology.

A: Sounds good to me.

Q: Some clarification questions on slide 3.

**24/1172r1 CSD Indication Design (Bo Gong)**

Didn’t finish the presentation due to audio issue.

**24/1230r1 Pilot tone design in DRU transmission (Lin Yang)**

Proposed pilot tone design for distribution BW 20/40/80MHz, in which pilot locations are optimized globally and systematically.

No SPs.

Q&A

Q: Some clarification questions. Some editorial comments.

Q: Request some simulation to prove this pilot tone plan is optimal.

A: With sufficient tone gap, we know there is sufficient diversity.

Q: Gap 10 is better for pilot tone for 20Mhz case on slide 5.

A: If the spacing is large enough, beyond a number of tones, there will not be more diversity gain.

Q: I don’t think there will be notable difference between 10 and 11 tone gap.

**24/1172r1 CSD Indication Design (Bo Gong)**

Propose that CSDs for each user are allocated by AP and the CSD start index for each user is indicated in the User Info field of the trigger frame.

No SPs.

Q&A

Q: The simulation is misleading in the slides. How can you assume all the users has perfect timing? It is not a practical assumption. Should simulation assuming reasonable error. Let AP to do optimization and choose CSD is not necessary and too complex.

Q: Signaling of CSD is too much to me. Prefer no CSD if need to signal CSD. With 1dB AGC gain, you may not even see any PER change.

A: For accuracy of AGC, if you have 3dB loss in AGC, you will have 3dB SNR loss. That’s big performance difference.

**Recess**

The meeting is recessed at 10:00 am ET.

# Wednesday July 17th, 2024, AM2

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 10:30am ET.
2. The Chair follows the agenda in IEEE 802.11-24/0976r6.
3. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
4. The Chair goes through the Copyright policy.
5. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
6. Discussions on the agenda. **DRU+MAP + Miscellaneous Part 1**
	* [24/1231](https://mentor.ieee.org/802.11/dcn/24/11-24-1231-00-00bn-uhr-ltfs-for-dru-and-sounding-operation.pptx) UHR LTFs for DRU and Sounding Operation Leonardo Lanante
	* [24/1245](https://mentor.ieee.org/802.11/dcn/24/11-24-1245-00-00bn-tone-distribution-in-dru-with-preamble-puncturing.pptx) Tone distribution in DRU with preamble puncturing Yan Xin

**Straw Polls:**

* + 11-24-0180-00-00bn-thoughts-on-the-beamforming-and-feedback Xiaogang Chen
	+ 11-23-1877-01-00bn-analysis-on-the-ldpc-rate-matching Xiaogang Chen
	+ 24/395r0 MU CSI FB Type for Non-TB sounding Junghoon Suh
	+ [24/1204](https://mentor.ieee.org/802.11/dcn/24/11-24-1204-00-00bn-coordinated-beamforming-for-11bn.pptx) Coordinated Beamforming for 11bn Insik Jung
	+ [24/1211](https://mentor.ieee.org/802.11/dcn/24/11-24-1211-00-00bn-coordinated-bf-goodput-discussion.pptx) Coordinated BF Goodput Discussion Genadiy Tsodik
	+ [24/1053](https://mentor.ieee.org/802.11/dcn/24/11-24-1053-00-00bn-papr-of-ofdma-transmission-follow-up.pptx) PAPR of OFDMA transmission follow up Xiaogang Chen
	+ 24/1124 Headroom Reason Reporting Brian Hart
	+ [24/1158](https://mentor.ieee.org/802.11/dcn/24/11-24-1158-00-00bn-uplink-mu-mimo-precoding-precoder-message-format.pptx) Uplink MU MIMO Precoding Precoder Message Format Rainer Strobel
	+ [24/1177](https://mentor.ieee.org/802.11/dcn/24/11-24-1177-00-00bn-additional-results-for-multi-layer-transmission.pptx) Additional Results for Multi-Layer Transmission Leif Wilhelmsson

**Technical contributions**

**24/1231r0 UHR LTFs for DRU and Sounding Operation (Leonardo Lanante)**

Propose to use LTF extensions for noise reduction of the channel estimates. Also NDPs only transmitting at exact tones where feedback is explicitly solicited.

No SPs.

Q&A

Q: Slide 4: If you have mixed size DRU in one transmission, will it be mixed 2x and 4x LTF?

A: If there is one 26 tone DRU, we will use 4x LTF for the whole PPDU.

Q: Why we only have 1x LTF for larger DRUs?

A: Our simulation shows it can achieve similar performance.

Q: Some clarification questions on slide 7.

Q: Slide 4: What is the goal for the proposal? For trigger frame we can configure the LTF mode.

A: Make sure the DRU with different size can support specific LTF size.

Q: Currently there is flexibility allowing AP to choose the LTF size.

A: There is no change in signaling. But to make sure some LTF sizes will be supported.

**24/1245r0 Tone distribution in DRU with preamble puncturing** **(Yan Xin)**

Proposed a tone distribution in DRU with preamble puncturing. Simple group index shifting is applied when one or two subchannels are unavailable for across 20 MHz tone distribution.

No SPs.

Q&A

Q: Do you consider the constant shift is with or without puncture?

A: For the tone shifting, slide 6 is without puncturing. Slide 5 shows shifting is based on DRU1.

Q: Will take a closer look to the difference of proposals. Request to defer the SP.

A: Ok with that.

**Straw Polls:**

**11-24-0180-00-00bn-thoughts-on-the-beamforming-and-feedback Xiaogang Chen**

**SP1: Do you agree to add to the 11bn SFD that the compressed beamforming matrix is the first subfield immediately following the MIMO control field in the compressed beamforming frame?**

Note: The Average SNR subfield is after the compressed bfing matrix subfield as shown in the figure below.



Y/N/A: 35% / 20% / 44%.

94 total voters. 5 more yes votes from the chat window. Results by votes 38/19/41

Q&A

Q: Some clarification questions on the SP. Some editorial comments to the SP text.

**11-23-1877-02-00bn-analysis-on-the-ldpc-rate-matching Xiaogang Chen**

**SP1: Do you agree that in an UHR MU PPDU, the transmitter may set the LDPC Extra Symbol Segment field to 1 regardless of the value derived from the calculations.**

* **Note: “UHR MU PPDU” is referring to a SU transmission or OFDMA transmission which includes more than one user. The name will be changed depends on the decision from the group.**

Q&A

Q: Commenter raised some technical issue for this SP. It’s different for DL and UL cases. For UL, it is ok to set this field to 0. We should not mix DL and UL together.

A: I mean give the flexibility to the Tx in this SP.

Q: We need to check the impact to implementation for your proposal. Request to defer the SP.

A: Will defer the SP.

**24/395r0 MU CSI FB Type for Non-TB sounding Junghoon Suh**

**SP1: Do you agree to add to the 11bn SFD that we support the MU CSI FB Type in a Non-TB Sounding?**

Y/N/A: 23% / 46% / 32%.

79 total voters. 6 more yes and 15 more no votes from the chat window. Results by votes: 24/51/25

Q&A

Q: Some editorial modification on the SP text.

Q: I don’t think we need to change non-TB sounding. I prefer to remove the non-TB sounding for UHR.

Q: Similar comment. How to do feedback need to see the big picture to find the best way to drive the need.

A: One AP and single user is a common case. Non-TB is good for this case.

**Technical contributions**

**24/1204r0 Coordinated Beamforming for 11bn (Insik Jung)**

Proposed further improvement by a precoding with partial nulling for C-BF.

No SPs.

Q&A

No discussion on the contribution.

**24/1211r1 Coordinated BF Goodput Discussion (Genadiy Tsodik)**

Propose to consider both CoSR and CoBF as candidate MAP schemes. The relevant scheme may be selected for operation based on channel conditions.

No SPs.

Q&A

Q: Is it possible that one STA finish traffic earlier than others?

A: I didn’t consider that scenario.

Q: My experience is that it is not very often for multiple STAs has 50KB or larger data at the same time. I wonder if the data arrives at slightly different time, what impact to the performance.

A: That is traffic model. How to get the traffic model is not covered in my slides.

**Recess**

The meeting is recessed at 12:25 pm ET.

# Wednesday July 17th, 2024, PM2

**Introduction**

1. The Chair (Dongguk Lim, LGE) calls the meeting to order at 4:00pm ET.

1. The Chair follows the agenda in IEEE 802.11-24/0976r8.
2. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
3. The Chair goes through the Copyright policy.
4. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Sigurd Schelstraete (MaxLinear) or the Chair himself if unable to record attendance via IMAT system.
5. Discussions on the agenda. **Miscellaneous Part 2 + LDPC Part 1**
	* [24/1053](https://mentor.ieee.org/802.11/dcn/24/11-24-1053-00-00bn-papr-of-ofdma-transmission-follow-up.pptx) PAPR of OFDMA transmission follow up Xiaogang Chen
	* [24/1124](https://mentor.ieee.org/802.11/dcn/24/11-24-1124-00-00bn-headroom-reason-reporting.pptx) Headroom Reason Reporting Brian Hart
	* [24/1158](https://mentor.ieee.org/802.11/dcn/24/11-24-1158-00-00bn-uplink-mu-mimo-precoding-precoder-message-format.pptx) Uplink MU MIMO Precoding Precoder Message Format Rainer Strobel
	* [24/1177](https://mentor.ieee.org/802.11/dcn/24/11-24-1177-00-00bn-additional-results-for-multi-layer-transmission.pptx) Additional Results for Multi-Layer Transmission Leif Wilhelmsson
	* [24/1054](https://mentor.ieee.org/802.11/dcn/24/11-24-1054-00-00bn-on-the-over-puncturing-in-ldpc.pptx) On the over puncturing in LDPC Xiaogang Chen
	* [24/1159](https://mentor.ieee.org/802.11/dcn/24/11-24-1159-00-00bn-investigation-of-ldpc-improvements.pptx) Investigation of LDPC Improvements Rainer Strobel

**Technical contributions**

**24/1053r0 PAPR of OFDMA transmission follow up (Xiaogang Chen)**

Proposed per RU pilot phase rotation to reduce the EVM and PAPR.

No SPs.

Q&A

Q: Need more time to evaluate. You provide more data and seems worth to study. Request to defer the SPs.

A: Ok to defer.

Q: Is this necessary to put in spec? This likely to be optional as recommendation, is this correct understanding?

A: Intention is to put in spec and make it mandatory. The sequence need to be standardized and the receiver need to know the sequence for equalization.

**24/1124r0 Headroom Reason Reporting** **(Brian Hart)**

Proposed enable the client to signal whenever a Local max TX power level is causing the TB PPDU Headroom to be 0 dB.

No SPs.

Q&A

Q: Suggest presenting in MAC or joint session.

**24/1158r0 Uplink MU MIMO Precoding Precoder Message Format** **(Rainer Strobel)**

Proposed feedback format details for UL MU MIMO precoding and some evaluation of quantization loss.

No SPs.

Q&A

Q: If AP get the V, AP can do some processing and feedback to the STA right?

A: The AP gets NDP and have the full channel knowledge. And AP feedback to the transmitter of the UL traffic. If the STA gets the V, it can already has ~3dB gain. And it can do better than that.

Q: Slide 6: what is the parameter for in the equation?

A: Make the precoding smoother in frequency domain. This is a small optimization,

Q: Request to defer the SP to give more time to study.

A: Fine with that.

Q: With different set of STAs, will you sound again?

A: Yes.

Q: You may need to sound for every PPDU.

A: Yes, for the worse case. But we expect to have a few transmissions for a configuration.

Q: Clarification question for beamforming and precoding and number of quantization bits etc.

Q: For UL, AP is hard to know the traffic especially for multiple STA. And this sounding will be very frequent, and overhead may kill the gain. This seems to be a bit over design.

A: Even for 2-3 users, you still get good gain. If you can get sufficient gain, this may make the UL MU-MIMO feature more attractive.

Q: 2 users don’t have much gain.

**24/1177r0 Additional Results for Multi-Layer Transmission (Leif Wilhelmsson)**

Provide more simulation results for multi-layer transmission.

No SPs.

Q&A

Q: Some clarification questions.

Q: If same MPDUs across the layers, this seems not work.

A: It’s different MPDUs for different layer.

Q: Need micro process on modulations. The amount of robustness of the two layers depends on Modulation level and not flexible enough.

A: If we make it more flexible, it will be more complex.

**24/1054r0 On the over puncturing in LDPC (Xiaogang Chen)**

Proposed to reduce or remove the combination of over puncturing in small RU/MRU for LDPC. Provide 2 options and descried the preference of opt 1.

No SPs.

Q&A

Q: For the excel sheet, can you add columns for N\_short and N\_punc? They should be proportional to coding rate. With these we can see whether it is really a problem. If the ratio is close to 1.2, it should be not much performance degradation.

A: I can look into it to add these columns and simulate the overall performance.

Q: With extra symbols, you will affect other users’ throughput.

A: For MU, nowadays we add extra symbol.

Q: Instead of adding more symbols, maybe lower MCS will not lead to shorter packet.

A: We can check with MAC to see is it feasible.

Q: For opt1, will you add one extra symbol or more extra symbols?

A: More than 1 symbol.

Q: Will this proposal only apply to small RU?

A: Over puncture issue happens more in small RU. For larger RU, it only happens with low MCS. Depends how much we want to optimize.

Q: Some clarification questions.

**Adjourn**

The meeting is adjourned for Wednesday at 5:55 pm ET.

# Thursday July 18th, 2024, AM1

**Introduction**

1. The Chair (Dongguk Lim, LGE) calls the meeting to order at 8:00am ET.

1. The Chair follows the agenda in IEEE 802.11-24/0976r9.
2. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
3. The Chair goes through the Copyright policy.
4. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Sigurd Schelstraete (MaxLinear) or the Chair himself if unable to record attendance via IMAT system.
5. Discussions on the agenda.  **LDPC + ELR**
* [24/1159](https://mentor.ieee.org/802.11/dcn/24/11-24-1159-00-00bn-investigation-of-ldpc-improvements.pptx) Investigation of LDPC Improvements Rainer Strobel
* [24/1184](https://mentor.ieee.org/802.11/dcn/24/11-24-1184-00-00bn-considerations-on-elr-transmission.pptx) Considerations on ELR transmission Dongguk Lim
* [24/1232](https://mentor.ieee.org/802.11/dcn/24/11-24-1232-00-00bn-thoughts-on-extended-long-range-transmission.pptx) Thoughts on Extended Long Range Transmission Leonardo Lanante
* [24/1255](https://mentor.ieee.org/802.11/dcn/24/11-24-1255-00-00bn-enhanced-long-range-frame-format.pptx) Enhanced Long Range Frame Format Junghoon Suh
* [24/1190](https://mentor.ieee.org/802.11/dcn/24/11-24-1190-00-00bn-performance-evaluation-of-longer-ldpc-for-11bn.pptx) Performance Evaluation of Longer LDPC for 11bn Shengquan Hu
* [24/1238](https://mentor.ieee.org/802.11/dcn/24/11-24-1238-00-00bn-2x1944-ldpc-codes-performance-evaluation.pptx) ldpc-codes-performance-evaluation Rong Zhang
* [24/1248](https://mentor.ieee.org/802.11/dcn/23/11-23-1248-00-00be-minutes-for-tgbe-phy-ad-hoc-july-2023-plenary.docx) 2xLDPC performance Juan Fang

**Technical contributions**

**24/1159r1 Investigation of LDPC Improvements (Rainer Strobel)**

Provided simulation results to compare performance of different length of LDPC codes and proposed to not support 2xLDPC codes on 2.4GHz to reduce the complexity.

No SPs.

Q&A

Q: Some clarification questions.

**24/1184r0 Considerations on ELR transmission (Dongguk Lim)**

Proposed options for ELR transmission. Opt1: ELR transmission is triggered in TB PPDU. Opt2: design of new ELR PPDU format to overcome the range imbalance on legacy SIG field.

No SPs.

Q&A

Q: Option 1 is not the good direction to go. We prefer ELR PPDU to be EDCA based transmission. Slide 6 simulation is a bit confusing, need some clarification. And the data part performance should be better.

A: I will check the simulation.

Q: Does option 2 also meet the target of 1.5Mbps?

A: Similar performance as option 1. Option 2 rate is slightly higher than option 1.

**24/1232r0 Thoughts on Extended Long Range Transmission (Leonardo Lanante)**

Proposed ELR PPDU preamble design options.

No SPs.

Q&A

Q: We may first consider which BW for ELR to operate. The regulatory could be different for sub 6GHz and 6GHz band.

Q: Some clarification questions.

Q: What is the symbol length for LLTF shown on slide 8.

A: Not 8us, 4us.

Q: Is the performance good with this assumption? We think need longer LTF symbol.

A: Yes. But we will check the simulation assumptions.

Q: For predetermined SIG field, the length and TXOP duration field should be random. We may have multiple modes for data and may need indication in SIG.

A: These signaling will go to ELR SIG.

**24/1255r0 Enhanced Long Range Frame Format (Junghoon Suh)**

Propose detailed design for ELR PPDU.

No SPs.

Q&A

Q: Slide 5: If we rely on Packet detection on ELR STF, CCA will be problematic. Lost 3 slots lead to big disadvantage for ELR STAs.

A: We are open to use LSTF for Packet detection.

Q: For simulation part, let’s have further discussions.

Q: Some questions on legacy misdetection.

A: I don’t think legacy device will recognize this ELR PPDU since numerology is different.

Q: If you do relay, the DL/UL imbalance still exists. Don’t know why link relay with ELR. Relay does not solve the problem.

**24/1190r1 Performance Evaluation of Longer LDPC for 11bn (Shengquan Hu)**

Shared some performance evaluation, observations and views for longer LDPC with codeword length 2x1944 in 11bn. Propose the adoption of 2x1944 LDPC codes for 11bn.

No SPs.

Q&A

Q: Some question on understanding of where the gain comes from and why higher MCS has higher gain.

A: Explained the reason why higher MCS has larger gain.

Q: Has some related proposal and need discussion.

A: Will check the proposal.

**24/1238r0 ldpc-codes-performance-evaluation (Rong Zhang)**

Shared simulation results for longer LDPC codes. Propose the adoption of longer LDPC codes.

No SPs.

Q&A

No discussions.

**24/1248r0 2xLDPC Performance (Juan Fang)**

Provided performance comparisons across payload sizes before and after incorporating the 2xLDPC codeword within the existing framework of LDPC encoding and rate matching procedures. Propose to consider 2xLDPC codeword in 11bn to enhance the reliability.

No SPs.

Q&A

No discussions.

Discussions on the agenda for AM2. Request to present related contribution before SP.

**Recess**

The meeting is recessed at 10:00 am ET.

# Thursday July 18th, 2024, AM2

**Introduction**

1. The Chair (Dongguk Lim, LGE) calls the meeting to order at 10:30am ET.

1. The Chair follows the agenda in IEEE 802.11-24/0976r10.
2. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
3. The Chair goes through the Copyright policy.
4. The Chair reminds everyone to report their attendance by using IMAT system and by sending an e-mail to the Co-chair, Tianyu Wu (Apple), Sigurd Schelstraete (MaxLinear) or the Chair himself if unable to record attendance via IMAT system.
5. Discussions on the agenda.  **ELR + Miscellaneous Part 2**
	* [24/1267](https://mentor.ieee.org/802.11/dcn/24/11-24-1267-00-00bn-further-considerations-for-uhr-preamble.pptx) Further Considerations for UHR preamble\* Sigurd Schelstraete

**Straw Polls**

* + [24/0876](https://mentor.ieee.org/802.11/dcn/24/11-24-0876-00-00bn-uhr-ppdu-phy-version.pptx) UHR PPDU PHY Version Rui Cao
	+ [~~24/0734~~](https://mentor.ieee.org/802.11/dcn/24/11-24-0734-01-00bn-on-ueqm-and-ueq-mcs.pptx) ~~On UEQM and UEQ-MCS Ron Porat~~
	+ [24/0474](https://mentor.ieee.org/802.11/dcn/24/11-24-0474-01-00bn-uhr-unequal-modulation-pattern-and-new-mcs.pptx) UHR unequal modulation pattern and new MCS Rui Cao
	+ [~~24/0875~~](https://mentor.ieee.org/802.11/dcn/24/11-24-0875-01-00bn-uhr-enhanced-long-range-support.pptx) ~~UHR Enhanced Long Range Support Rui Cao~~
	+ [24/0873](https://mentor.ieee.org/802.11/dcn/24/11-24-0873-00-00bn-design-targets-and-considerations-for-enhanced-long-range.pptx) Design Targets and Considerations for Enhanced Long Range Jianhan Liu
	+ [24/1985](https://mentor.ieee.org/802.11/dcn/23/11-23-1985-04-00bn-longer-ldpc-codeword.pptx) Longer LDPC Codeword Rethna Pulikkoonattu

**Submissions – ELR + Miscellaneous Part 2 – cont’d**

* + [24/1264](https://mentor.ieee.org/802.11/dcn/24/11-24-1264-00-00bn-supporting-rx-interference-mitigation-in-tgbn.pptx) Supporting Rx Interference Mitigation in TGbn Shimi Shilo
	+ [24/1265](https://mentor.ieee.org/802.11/dcn/24/11-24-1265-00-00bn-triggered-beamforming-in-tgbn-more-insights.pptx) Triggered Beamforming in TGbn – More Insights Shimi Shilo

**Technical contributions**

**24/1267r0 Further Considerations for UHR preamble (Sigurd Schelstraete)**

Discuss the impact to UHR preamble from mixed 11be and 11bn OFDMA transmission. Propose to consider preamble design to support a mix of EHT and UHR STAs in a single OFDMA transmission.

No SPs.

Q&A

Q: The mixed mode OFDMA is not very important, and it seems to be an overdesign. We should stick to the design that each PHY version has different PHY version ID.

A: I listed a number of benefits for this mode.

Q: Is this same as APPDU?

A: APPDU is per band different PHY PPDU format. This proposal it is just mix in the same band using OFDMA in a single frame.

Q: We already allow that since UHR STA is also a EHT STA.

A: UHR has new features on top of EHT. There are benefits to enable UHR features.

Q: For UHR feature, simply use UHR PPDU will make things easier. Prefer APPDU than mix some UHR feature in EHT PPDU.

**Straw Polls**

**24/0876r0 UHR PPDU PHY Version (Rui Chao)**

SP1: **Do you agree to add the following to 11bn SFD:**

* “PHY version identifier” is set to 1 in U-SIG for UHR PPDUs?

Y/N/A: 84% / 3% / 13% total votes: 128. 4 yes from chat window

Calculated results in votes: Y/N/A: 112/4/17

Q&A

Q: Does this include ELR?

A: Yes, for all PPDU formats defined in UHR.

**24/0474r2 UHR unequal modulation pattern and new MCS** **(Rui Chao)**

SP1: **Do you support to include in the 11bn SFD:**

* Define unequal modulation over different spatial streams?

Y/N/A: 90% / 3% / 7% total votes: 124. 4 yes from chat window

Calculated results in votes: Y/N/A: 116/4/9

Q&A

No discussion

**24/0873r2 Design Targets and Considerations for Enhanced Long Range (Jianhan Liu)**

SP1: Do you support to include the following in the 11bn SFD?

* Define Enhanced Long Range (ELR) PPDU and potentially other Range Extension mechanisms.

Y/N/A: 85% / 5% / 12% total votes: 135. 3 yes from chat window

Calculated results in votes: Y/N/A: 118/7/16

Q&A

No discussion.

**24/1985r5 Longer LDPC Codeword (Rethna Pulikkoonattu)**

SP1: Do you support to include the following in the 11bn SFD:

* Define LDPC codeword length larger than 1944, including 2x1944

Y/N/A: 83% / 2% / 16% total votes: 128. 7 yes from chat window

Calculated results in votes: Y/N/A: 113/3/20

Q&A

Q: Is it mandatory or optional?

A: Too early to decide.

Q: Do you consider other codeword size?

A: It is open.

Q: Some SP text discussions. And decide to keep the current SP text.

**Technical contributions**

**24/1264r0 Supporting Rx Interference Mitigation in TGbn (Shimi Shilo)**

Proposed that TGbn will support an interference mitigation mode in order to reach this ultra-high-reliability target.

No SPs.

Q&A

No discussions.

**24/1265r0 Triggered Beamforming in TGbn – More Insights (Shimi Shilo)**

Provided more simulation results and discussed non-triggered per-STA precoding, its performance compared with triggered (joint) precoding and the reason for the performance gap. Proposed to support precoded TB PPDUs in 11bn.

No SPs.

Q&A

No discussions.

**24/1295r0 Long LDPC Designs Based on 11n LDPC Codes (Wei Lin)**

Provided 2x-LDPC codes based on 11n 1944 LDPC matrices. Propose to further fine tuning to improve both decoding thresholds and error floors.

No SPs.

Q&A

No discussions.

**Adjourn**

The meeting is adjourned for the week at 12:00 pm ET.