IEEE P802.11  
Wireless LANs

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| Minutes 802.11 bn PHY ad hoc – Jan Interim meetings | | | | |
| Date: 2024-01-18 | | | | |
| Author(s): | | | | |
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Abstract

This document contains the PHY ad hoc meeting minutes for TGbn teleconferences held on:

* Tuesday AM1, Jan 16, 2024
* Tuesday PM1, Jan 16, 2024
* Wednesday AM1, Jan 17, 2024
* Wednesday AM2, Jan 17, 2024
* Thursday AM1, Jan 18, 2024

**Tuesday Jan 16th, 2024 08:00 – 10:00 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 08:00am ET.
2. The Chair follows the agenda in 11-24/2174r6.
3. Reminder for registration for the Interim meeting.
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), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
5. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
6. The Chair goes through the Copyright policy.
7. Discussions on the agenda.
   * [23/1919](https://mentor.ieee.org/802.11/dcn/23/11-23-1919-00-00bn-dru-proposal.pptx) dRU Proposal Eunsung Park
   * [23/1988](https://mentor.ieee.org/802.11/dcn/23/11-23-1988-00-00bn-considerations-on-dru-design-and-application.pptx) High Level Thoughts on DRU Design Lin Yang
   * [23/2020](https://mentor.ieee.org/802.11/dcn/23/11-23-2020-00-00bn-high-level-perspective-on-distributed-tone-ru-for-11bn.pptx) High Level Perspective on Distributed Tone RU for 11bn Shengquan Hu
   * [23/2021](https://mentor.ieee.org/802.11/dcn/23/11-23-2021-00-00bn-principle-and-methodology-for-dru-tone-plan-design.pptx) Principle and Methodology for dRU Tone Plan Design Shengquan Hu

**Technical contributions**

1. **23/1919r0 dRU Proposal – Eunsung Park (LGE)**

Discussions:

C: Pilot tones are not evenly distributed when combination two dRUs. We need some design to keep the pilot tones evenly distributed.

C: Limit number of dRUs are beneficial to simplicity of implementation.

C: Slide 11, why cut small dRUs for 80MHz channel? How about define dRU-106 for 80MHz.

C: Slide 9: it is not easy to support 160MHz due to per 80MHz segment parser.

A: We may bypass segment parse.

C: For mixed dRU and rRU in 320MHz, how can you process them?

A: Process per 160MHz.

C: Then they have different processing path. Complexity is high.

C: Support consider small dRU in 80MHz. Also interested in dRU in 160MHz.

C: Study the power boosting gain with small dRU to help make decision what mode to support.

C: We may also support dRU in band other than LPI channels as long as we can find gain.

C: For dRU in 20MHz TB PPDU, do we support triggering just one STA with dRU or 9 STAs with dRU? Is it allowed to have 9 STAs with power boost?

A: Our understanding is this is allowed.

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

* 11bn supports a dRU for a TB PPDU transmission in a 6 GHz band
  + The dRU means an RU which consists of subcarriers spreading across a certain channel
  + Whether it is mandatory or optional is TBD
  + Details on the size, subcarrier indices and the number of dRUs are TBD
  + Support for dRUs in other PPDUs and different bands is TBD

Discussions on SP:

C: Remove 6GHz band. Should allow other bands.

C: Should we look at all related contributions before running SPs?

A: Prefer to run this high level one but no other SPs with details.

C: Remove band and all the TBDs.

C: Suggest running harmonized SP after all submissions on this topic.

C: Suggest naming distributed RU as DRU instead of dRU.

SPs deferred.

1. **23/1988r1 High Level Thoughts on DRU Design – Lin Yang (Qualcomm)**

Discussions:

C: Can we support mixed DRU? Small DRU in 20MHz and larger DRU across 80MHz.

A: There will be power imbalance. For the 20MHz with more populated tones, there will be higher power.

C: Slide 4: Don’t exclude DRU in SU case. Un-populated tones are wasted is not accurate.

C: Slide 12: no hybrid mode is too restricted.

C: The restrictions need more discussion such as BW limitation. Prefer not exclude any possible feature at this starting point.

C: If 20MHz only STA mix with 80MHz operation STAs, may need to define 60MHz DRU, which is too complicated. If some devices are 20MHz only, maybe not mix with other operation BW to reduce complexity.

1. **23/2020r1 High Level Perspective on Distributed Tone RU for 11bn** **– Shengquan Hu (Mediatek)**

Discussions:

No discussion due to time limit.

**Recess**

The meeting is Recessed at 10:00am ET.

**Tuesday Jan 16th, 2024 13:30 – 15:30 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 13:30pm ET.
2. The Chair follows the agenda in 11-24/2174r6.
3. Reminder for registration for the Interim meeting.
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), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
5. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
6. The Chair goes through the Copyright policy.
7. Discussions on the agenda.
   * [23/2021](https://mentor.ieee.org/802.11/dcn/23/11-23-2021-00-00bn-principle-and-methodology-for-dru-tone-plan-design.pptx) Principle and Methodology for dRU Tone Plan Design Shengquan Hu
   * [23/2031](https://mentor.ieee.org/802.11/dcn/23/11-23-2031-00-00bn-data-tones-grouping-in-tone-distributed-rus.pptx) Data Tones Grouping in Tone-Distributed RUs Mahmoud Kamel
   * [23/2200](https://mentor.ieee.org/802.11/dcn/23/11-23-2200-00-00bn-distribution-bandwidth-of-dru.pptx) Distribution bandwidth of DRU Ross Jian Yu
   * [24/0014](https://mentor.ieee.org/802.11/dcn/24/11-24-0014-00-00bn-further-thoughts-on-dru.pptx) Further Thoughts on dRU Eunsung Park

**Technical contributions**

1. **23/2020r1 High Level Perspective on Distributed Tone RU for 11bn** **– Shengquan Hu (Mediatek)**

Continue with Q/R

Discussions:

C: Slide 10: 20MHz hybrid mode is not supported right?

A: Hybrid mode is per 80MHz subblock based.

C: 20MHz operation device can’t participate in hybrid mode then?

A: 20MHz operation device can use 20MHz PPDU. Can further discuss this problem.

C: Slide 10: If 20MHz operation STA do not support DRU, it cannot participate in 160/320MHz transmission. Is your intention to mandate 20MHz operation device to support DRU?

A: Can further discuss this mode.

1. **23/2021r1 Principle and Methodology for dRU Tone Plan Design – Shengquan Hu (Mediatek)**

Discussions:

C: 26 tone DRU in 40MHz will have 18 tone spacing, how do you get the smoothing gain with 18 tone spacing?

A: In general, when the tone spacing gets larger, regular RU smoothing method may not work. How to choose the smoothing filter depends on tone correlation can be optimized. The smoothing gain is smaller but can still observe >1dB smoothing gain.

C: Slide 4: why only support 8 DRU26 instead of 9 DRU26?

A: There are a list of design criteria on slide 3 and it is hard to meeting all the requirements with 9 DRUs.

C: Slide 5: clarification questions on tone plan.

1. **23/2031r2 Data Tones Grouping in Tone-Distributed RUs – Mahmoud Kamel (Interdigital)**

Discussions:

C: Slide 5: There is ~1.7dB power boost lost with tone grouping, have you check 106/242 tone DRU in 40MHz what is the power boost lost?

A: The design criteria is if #tones/MHz limit is reached, group them to get some smoothing gain. If not, study the tradeoff between power boost gain and smoothing gain.

C: Slide 12: clarification on simulation settings. There is no power boosting in the results in slide 12.

1. **23/2200r0 Distribution bandwidth of DRU – Ross Jian Yu (Huawei)**

Discussions:

C: 2 users for 160MHz as candidate in your slides. But we can support 18dBm already. Do we need to push to 21dBm?

A: Always good to have 3dB more to support higher MCS level.

C: Slide 4: What is the benefit to allow 20MHz dist BW in 80MHz punctured case?

A: Limit the modes.

C: To limit the modes, only support option 1 on this slide is good enough.

A: We can discuss the options but we are also prefer to just select one option.

C: Slide 6: How A-PPDU can replace hybrid mode?

A: A-PPDU can be all UHR PPDU with one PPDU supporting DRU other PPDU using RRU.

1. **24/0014r0 Further Thoughts on dRU – Eunsung Park (LGE)**

Discussions:

C: Slide 7: You mentioned to combine DRUs with similar power boost gain, DRU 106+DRU 52 will generate a new RU size not supported in 11be.

A: Agree that define new RU size will need new coding design etc.

C: Slide 7: For 52+ 26 tone, although the power boost gain is the same, the Tx power is different.

A: Subcarrier spacing for 52 in 40MHz and 26 tone in 20MHz is the same, per tone power is the same.

C: The small MRU is not widely used. The DRU design can first focus on simple cases and leave DRU in MRU to be considered later.

A: This is useful in 80MHz punctured case.

C: The two DRUs are using same coding, right?

A: Yes.

SP#1: (from 23/1988r1)

**Do you agree to include the following text to the 11bn SFD:**

* **11bn will define distributed tone RU (“DRU”) transmission**

Unanimous consent with no objection

**Recess**

The meeting is Recessed at 15:30pm ET.

**Wednesday Jan 17th, 2024 08:00 – 10:00 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 08:00am ET.
2. The Chair follows the agenda in 11-24/2174r7.
3. Reminder for registration for the Interim meeting.
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), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
5. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
6. The Chair goes through the Copyright policy.
7. Discussions on the agenda.
   * SPs on DRU (23/1919r1) Eunsung Park
   * [23/1927](https://mentor.ieee.org/802.11/dcn/23/11-23-1927-00-00bn-update-of-the-spatial-modulation.pptx) Update of the Spatial Modulation Junghoon Suh
   * [23/1944](https://mentor.ieee.org/802.11/dcn/23/11-23-1944-01-00bn-impact-of-tx-evm-on-mimo-detection.pptx) Impact of Tx EVM on MIMO Detection Shimi Shilo
   * [23/2115](https://mentor.ieee.org/802.11/dcn/23/11-23-2115-00-00bn-an-approach-to-enhance-the-reliability-for-wi-fi-networks.pptx) An Approach to Enhance the Reliability for Wi-Fi Networks Haji M. Furqan
   * [24/0100](https://mentor.ieee.org/802.11/dcn/24/11-24-0100-00-00bn-vendor-specific-phy-signalling.pptx) Vendor Specific PHY Signaling Brian Hart

**Technical contributions**

1. **23/1919r1 DRU Proposal – Eunsung Park (LGE)**

**SP#1: Do you agree to add the following text to the TGbn SFD?**

* + 11bn supports a distributed-tone RU (DRU) for a TB PPDU transmission
    - The DRU means an RU which consists of subcarriers spreading across a certain bandwidth

Unanimous consent with no objection

1. **23/1927r1 Update of the Spatial Modulation – Junghoon Suh (Huawei)**

Discussions:

C: This scheme seems dependent on channel conditions. Can you show the results for just the antenna selection bits to show the detection reliability? For some tones, the channel could be similar between antenna and could be hard to detect the antenna selection bits.

A: I tested channel D, performance is similar for coded and uncoded cases.

C: Slide 10: Can you show the results for 4x1, 8x2, 8x4, 16x2 etc?

A: For 4x1 the performance will be even better. For some cases the computational complexity is too high.

C: Slide 4: Randomly should be data dependently.

C: Slide 12: Why RX SNR is 6dB higher than Tx SNR?

A: Fading is not considered in red curve but considered in black curve.

C: Then Rx SNR is the regular SNR definition, and we need 46 dB? That is too high.

C: Do you considered the error propagation? If antenna selection is wrong, then the regular data streams could be wrong.

A: Tested channel D and performance is same for coded and uncoded cases. So very reliable and no need to waste the throughput for coding.

C: Can this be applied to MU case?

A: No, just for SU.

**SP#2:** **Would you like to explore the Spatial Modulation technology as one of the feature to improve the SU-MIMO performance in the UHR?**

Yes/No/Abstain: 27/32/21

1. **23/1944r2 Impact of Tx EVM on MIMO Detection – Shimi Shilo (Huawei)**

Discussions:

C: Slide 8: What is the performance if you apply whitening for 7.4dB power back off case.

A: We can do that.

C: From your results 1dB extra BO brings more than 1dB gain.

A: Right.

C: What is the PA model you used?

A: RAPP model which is reasonably accurate. We are working on model more precise to WLAN.

C: Slide 8: 1dB BO takes you out of range. It is a bit strange to see this big impact.

A: It is nonlinear in PA BO. We will also include more impairments.

1. **23/2115r0 An Approach to Enhance the Reliability for Wi-Fi Networks – Haji M. Furqan (Vestel Elektronik Sanayi ve Ticaret A.S.)**

Discussions:

C: For the deep faded region, OFDMA + MU-MIMO can resolve the issue with good user allocation.

A: There is still chance to have deep fading channel in frequency selective channel.

**SP#3:** **Are you in favor of supporting the new concept of transmission for MU MIMO networks in TGbn?**

**Yes/No/Abstain: 6/40/31**

1. **24/0100r0 Vendor Specific PHY Signaling – Brian Hart (Cisco)**

Discussions:

C: No against this direction, but SIG field need to design as a whole to see how many features we have and how many bits we need.

C: Slide 6: Need more time to understand why vendor specify signaling is needed and how to use it.

A: Some STA in the ecosystem may benefit with the vendor knowledge to optimize the Rx.

C: Slide 6: The contents seem varying, consider simplify the content.

A: We need to consider common signaling and per user signaling.

C: If VS SIG part of U-SIG?

A: Yes, in U-SIG.

C: I see VS field in TB PPDU, do you also want to define it in Trigger frame?

A: It makes sense to me but not part of this proposal.

C: What is the use case for VS? Example of TX EVM you mentioned may not need signaling.

A: Slide 15 listed some use cases.

C: As in slide 3, you mentioned BSS color, STA ID is not sufficient, can we add BSSID to solve the problem?

A: BSSID is 48 bits, too much overhead. Also, BSS color may need to change when STA is moving.

C: If BSS color is from your AP, STA can optimize and improve the performance, if it is from OBSS and STA detected wrong, it does not matter since the PPDU is not for the STA anyway.

A: Slide 3 listed some cases STA do need to know the VS information.

**Recess**

The meeting is Recessed at 10:00am ET.

**Wednesday Jan 17th, 2024 10:30 – 12:30 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 10:30am ET.
2. The Chair follows the agenda in 11-24/2174r7.
3. Reminder for registration for the Interim meeting.
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), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
5. The Chair goes through the IPR policy and asks if anyone is aware of any potentially essential patents. **Nobody speaks up.**
6. The Chair goes through the Copyright policy.
7. Discussions on the agenda.
   * Q/A continue for [24/0100](https://mentor.ieee.org/802.11/dcn/24/11-24-0100-00-00bn-vendor-specific-phy-signalling.pptx) Vendor Specific PHY Signaling Brian Hart
   * [23/1998](https://mentor.ieee.org/802.11/dcn/23/11-23-1998-00-00bn-zero-mui-coordinated-bf.pptx) Zero MUI Coordinated BF Shimi Shilo
   * [24/0010](https://mentor.ieee.org/802.11/dcn/24/11-24-0010-00-00bn-coordinated-beamforming-for-802-11bn.pptx) Coordinated Beamforming for 802.11bn Okan Mutgan
   * [24/0011](https://mentor.ieee.org/802.11/dcn/24/11-24-0011-00-00bn-coordinated-spatial-nulling-c-sn-concept.pptx) Coordinated Spatial Nulling (C-SN) Concept Rainer Strobel
   * [24/0012](https://mentor.ieee.org/802.11/dcn/24/11-24-0012-00-00bn-coordinated-spatial-nulling-c-sn-simulations.pptx) Coordinated Spatial Nulling (C-SN) Simulations Rainer Strobel

**Technical contributions**

1. **Q/A for 24/0100r0 Vendor Specific PHY Signaling – Brian Hart (Cisco)**

Discussions:

C: Some clarification questions.

1. **23/1998r0 Zero MUI Coordinated BF – Shimi Shilo (Huawei)**

Discussions:

C: We propose STA feedback a large V for CSI as it does today with no change to STA. Your proposal requires STA to change the feedback.

A: Today AP indicates STA how many columns to feedback. We maintain same type of feedback with small overhead.

C: U matrix may not be used due to interference between streams. With channel aging etc, STA may also use different matrix from U matrix. Receiver filter will change with channel change.

A: That need to be evaluated with simulation.

C: Slide 16: This requires doing SVD and U matrix multiplication in a few micro seconds?

A: You don’t need to do SVD. Can use less complex decomposition algorithm such as QR.

C: Slide 16: U matrix is not used to equalize the MIMO channel, instead it is used for preprocessing?

A: Here U matrix is just for feedback. AP take U\*H as equivalent channel.

C: STA1 will use U1 at its receiver, AP2 need to know U1 to null the equivalent channel to STA1.

1. **24/0010r0 Coordinated Beamforming for 802.11bn – Okan Mutgan (Nokia)**

Discussions:

C: This is a good start. But it is still premature to conclude on this topic. It’s not sure about the gain vs overhead in different scenarios. Request to defer this SP.

C: Agree this feature need more study. Also there are other related features such as CSR that we may want to consider together.

A: Agree there will be a lot of issue to consider. Ok to defer the SP.

1. **24/0011r0 Coordinated Spatial Nulling (C-SN) Concept – Rainer Strobel (Maxlinear)**

Discussions:

C: Clarification questions: Do you assume backhaul exists?

A: Each STA will feedback to the AP it associates. APs need some exchange to jointly optimization.

C: Is the overhead include AP to AP traffic?

A: The communication between APs don’t count into overhead. Assuming backhaul.

C: How often do you do the sounding?

A: Sounding every 12ms.

C: That is frequency sounding, but you only get small overhead?

A: Can double check the overhead.

C: Do you assume U from NDP applies to other PPDU? In reality, different packet may have different signal strength, AGC etc. Especially from different APs, the signal strength can be quite different.

A: This is not modeled in the simulation. Need more check.

C: Slide 10: What scenario do you assume in your simulation?

A: Simulation is in another contribution. Assumption is slow moving with 1.5km/h speed.

C: CBF is turning SU beamforming issue into MU beamforming issue which is much more complicated. The benefit is shown for ideal cases, need to consider benefit in more practical scenarios.

A: Already considered some impairments.

C: The baseline is MU-MIMIO TDMA, what does that mean?

A: MU-MIMO which no contention and no collision. Just sequential traffic.

C: 12ms sounding period brings lots of overhead, do you consider implicit feedback?

A: Implicit feedback is difficult.

1. **24/0012r0 Coordinated Spatial Nulling (C-SN) Simulations – Rainer Strobel (Maxlinear)**

Discussions:

C: Comparison between C-SR and C-SN.

A: We also have analysis on C-SR before in reference 3 and 4.

C: Slide 6: The setting for C-SR is not the usage scenario for C-SR.

C: Nulling approach is also a kind of SR. Need to be careful to define the terms.

A: Agree.

C: Slide 5 results show C-SR performance is not good but there are better designs for C-SR.

A: There are always some interferences in CSR which depredates the performance.

**Recess**

The meeting is Recessed at 12:30pm ET.

**Thursday Jan 18th, 2024 08:00 – 10:00 ET**

**Introduction**

1. The Chair (Sigurd Schelstraete, MaxLinear) calls the meeting to order at 08:00am ET.
2. The Chair follows the agenda in 11-24/2174r9.
3. Reminder for registration for the Interim meeting.
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), Dongguk Lim (LGE) or the Chair himself if unable to record attendance via IMAT system.
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6. The Chair goes through the Copyright policy.
7. Discussions on the agenda.
   * [24/0016](https://mentor.ieee.org/802.11/dcn/24/11-24-0016-00-00bn-uhr-mimo-rvr-enhancement-with-unequal-modulation.pptx) UHR MIMO RvR enhancement with unequal modulation Rui Cao
   * [24/0113](https://mentor.ieee.org/802.11/dcn/24/11-24-0113-00-00bn-unequal-modulation-in-mimo-txbf-in-11bn.pptx) Unequal Modulation in MIMO TxBF in 11bn Alice Chen
   * [24/0117](https://mentor.ieee.org/802.11/dcn/24/11-24-0117-00-00bn-improved-tx-beamforming-with-ueqm.pptx) Improved Tx Beamforming with UEQM Ron Porat
   * [24/0107](https://mentor.ieee.org/802.11/dcn/24/11-24-0107-00-00bn-phy-layer-interference-mitigation-for-improved-reliability.pptx) PHY Layer Interference Mitigation for Improved Reliability Shimi Shilo
   * [24/0025](https://mentor.ieee.org/802.11/dcn/24/11-24-0025-00-00bn-phy-modifications-for-high-mobility-stas.pptx) PHY modifications for high-mobility STAs Azin Neishaboori
   * [24/41r0](https://mentor.ieee.org/802.11/dcn/24/11-24-0041-01-00bn-dpwifi-matlab-validation.pptx) DPWiFi MATLAB Validation Carlos Rios

**Technical contributions**

1. **24/0113r0 Unequal Modulation in MIMO TxBF in 11bn – Alice Chen (Qualcomm)**

Discussions:

C: Slide 6: There are lots of frequency diversity, how do you calculate the coding gain? How do you accumulate the instantaneous coding gain across tones and streams.

A: This is similar to baseline 11be coding gain.

C: Slide 6: Do you allow QPSK 5/6 in one stream?

A: Yes, the green curve (optimal curve) allows QPSK 5/6.

C: Are we define new MCSs in unequal MCS, we should allow the new MCS in general transmission.

A: Depends on how you define the new MCS, in general yes.

C: Is there gain for unequal MCS comparing to control the power in streams with equal MCS?

A: That’s one way but we didn’t simulate that. We believe there is gain.

C: We have simulations to compare both scheme and see big gain with unequal MCS.

C: To maximize the gain, we should allocate higher power (power waterfilling algo) to stronger stream. Suggest allowing unequal power allocation.

C: Do you apply the unequal MCS to SU MIMO or MU-MIMO?

A: Just SU-MIMO with beamforming.

C: There are two schemes to deal with different eigen values among different streams: precoding method vs unequal MCS. We did the simulation and find precoding scheme didn’t bring much gain.

C: This is just the presentation to point out the direction. For all following contributions, we need to make sure the scheme works in practice and will be tested.

C: Why not further optimize with optimal power allocation among schemes?

A: Change power allocation just change the distribution of the SNR with larger gap between streams.

1. **24/0016r0 UHR MIMO RvR enhancement with unequal modulation – Rui Cao (NXP)**

Discussions:

C: Slide 15: Did you use power water filling to optimize the power?

A: No, simulation is based on equal power. We did check the power loading but didn’t see much gain.

C: Where is the gain come from without power water filling?

A: Unequal MCS match the QAM to the per stream SNR so LLR is at similar level for different stream. If using power loading and equal MCS, it is allocating more power to the weaker stream which is opposite of power waterfilling. It is not capability achieving.

C: Without power waterfilling, the gain looks too big.

C: What is the PER in your simulation.

A: This is goodput, we didn’t have PER requirement. We pick the MCS to achieve max goodput.

C: Segment parser also need some change. We should try to limit the combinations of the unequal MCS.

A: Agree we should pick the set of most useful modes.

C: Need to compare Unequal MCS vs Unequal modulation both has benefits. Unequal MCS provide separate protection and avoid error propogation.

A: We compared both and they achieve similar gain.

C: Power waterfilling is not very important here. First choose optimal number of streams is already taking power waterfilling into consideration. Second, we don’t have infinite modulation and code rate to matching the optimized power allocation.

1. **24/0117r0 Improved Tx Beamforming with UEQM – Ron Porat (Broadcomm)**

Discussions:

C: Are you using eigen beamforming in the simulation?

A: Yes

C: Did you try other beamforming such as zero forcing?

A: No, that’s not the best scheme.

C: Some clarification questions.

**SP#1:** Do you agree to add to the 11bn SFD:

11bn supports unequal modulation (UEQM) with single encoder for all spatial streams and different modulation per spatial stream for beamforming with at least 2ss

- This is used for single user MIMO beamforming transmission in full bandwidth or OFDMA

**SP deferred.**

Discussions:

C: Can you clarify in the SP it only applies to SU-MIMO?

A: Change to SU beamforming and BF in OFDMA

C: Change BF to beamforming.

C: Some more editorial change to the SP text.

C: Request to defer the SP.

C: For the sub bullet: for single user in full bandwidth or OFDMA

C: Why limit to 1 encoder in the SP.

A: We see proposal with 2 encoder/decoder. That is to complicate for the STA and not much extra gain.

C: A few more requests to defer the SP.

A: Agree to defer the SP.

C: The SP text is a bit misleading with single encoder per spatial stream.

A: Updated the SP text.

C: BPSK/QPSK are not QAM. Change to modulation. Change QAM to modulation.

A: Updated.

**Adjourn**

The meeting is Adjourned at 9:55am ET.