IEEE P802.11
Wireless LANs

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| Minutes for Task Group (TG) 802.11 beExtremely High ThroughputJuly 2019 Meeting, in Vienna, Austria |
| Date: 2019-07-22 |
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Abstract

This document contains the meeting minutes of the 6 IEEE 802.11be TG sessions held in the July 2019 plenary meeting.

Rev0: First version of the document.

**Monday 15 July 2019, PM2 Session**

**Introduction**

1. At 4:01 PM, the Chair, Alfred Asterjadhi (Qualcomm), calls the meeting to order. He reminds the group to announce your affiliation when you first address the group. Around 175 people in the room.
2. The Chair goes through the attendance, voting and and document status.
3. The Chair explains the patent policy and calls for potentially essential patents. Nobody speaks up.
4. Agenda for the week. The Chair if somebody wants to add anything to the agenda. Nobody speaks up. Motion to approve the agenda for the week passed with unanimous consent.
5. The agenda for this meeting. Agenda:
	* Call meeting to order
	* IEEE-SA IPR policy and Procedure
	* Set and approve agenda
	* Summary from May 2019 meeting
	* Approve TG minutes
	* Presentation of submissions
	* Recess
6. Two presentations added to the list of submissions.
7. Move to approve Tgbe minutes of meetings and teleconferences from May 2019 meeting to today:

<https://mentor.ieee.org/802.11/dcn/19/11-19-0957-01-00be-meeting-minutes-may-2019.docx>
<https://mentor.ieee.org/802.11/dcn/19/11-19-1075-01-00be-telephone-conference-meeting-minutes-june-2019.docx>

**Move:** Dennis Sundman (Ericsson) Second: Al Petrick (Jones-Petrick and Associates)
**Discussion:** No discussion

**Result:** Approved with unanimuous consent.
8. Alfred suggests that we list the submissions in terms of topic instead of dcn number. Some discussion regarding this. We try to list them according to topic.

Submissions

1. 11-19/0763r0, ”Measurements for Distributed-MU-MIMO” – Miguel Lopez (Ericsson)

**Summary:** A comparison between 3 different MU-MIMO techniques based on actual channel measurements: Joint processing transmissions (JPT), coordinated beamforming (CBF), OBSS (baseline). They provide plots and claims that JPT performs much better than CBF and baseline in this setup.

**C:** You say the measurements are ideal, this sounds like a contradiction?
**A:** Yes maybe we should say semi-ideal. The channels are measured in a way that provides very high SNR. Practically I believe the channel knowledge can be considered ideal.
**C:** What about synchronization etc?
**A:** Ideal.
2. 11-19/0779r1, ”Performance Investigation on Multi-AP Transmission”, Eunsung Park (LG Electronics)

**Summary:** Several cases are simulated to compare joint transmission (JTX), single transmissions (STX), non-coordinated transmission (non-CTX), coordinated beamforming (CBF). Some assumptions. They provide plots and claims that JTX performs better compared to other schemes.

**C:** Can you explain why the performance of JTX doesn’t change when the distances change?
**A:** I think the distance is small enough.
**C:** What were the PER in these simulations?
**A:** Less than 10%.
**C:** I have a question about the 100 m on slide 8. Can we guarantee synchronization at this distance?
**A:** I think a master AP can orchestrate these slave APs so that they are synchronized.
**C:** How do you simulate 10 MHz frequency errors? Do you simulate the phase drift during a transmission?
**A:** No.
**C:** For JTX you assume everything perfect?
**A:** No we assume compressed beamforming.
**C:** Did you consider overhead for the signaling beamforming?
**A:** No.
**C:** On slide 5. When you simulate the distance. The CSI should be less and less accurate, do you simulate this?
**A:** No.
**C:** Do you assume perfect CSI?
**A:** No.
3. 11-19/0799r1, ”Comparison of Coordinated Beamforming and Joint Transmission” – Ron Porat (Broadcom)

**Summary:** Additional performance plots showing the gains of joint transmission (JT). They have also tried the synchronization in products. They claim it works well. They show plots that JT performs much better compared to baseline. They believe accurate CFO is possible, that JT does not suffer performance loss from increasing BSS separation.

**C:** On slide 9. Is the CFO estimation procedure you have done here representative for how it would work in practice?
**A:** We can do it in any way, whichever way, we need some separation between LTFs.
**C:** I think you should consider power control.
**A:** I think all those details need to be studied but it is beyond this presentation.
**C:** With power control maybe performance can be enhanced.
**A:** Yes you are right.
**C:** Do you know how high the high SNR is?
**A:** Around 40 dB.
**C:** What about if we go to 30 dB, how will it change?
**A:** We haven’t looked at that, but we have simulations.
**C:** On slide 9, what is the 124 us?
**A:** That is the distance between the LTFs and we use it to calculate CFO.
**C:** What will happen in practice when the separation is larger? How will this affect performance?
**A:** We believe we need to have LTFs recurrently. The performance will degrade of course.
4. 11-19/1019r0, ”Virtual BSS for Multi-AP Coordination” – Wook Bong Lee (Samsung)

**Summary:** They want to introduce the Virtual BSS term. The APs for the virtual BSS can be dynamic. For the STA a virtual BSS should be quite transparent.

**C:** Sometimes multiple APs are transmitting to the same STA. How do you handle that they are using different channels etc?
**A:** We believe this has to be done at some kind of association.
**C:** You assume these APs are time and frequency synchronized?
**A:** Yes.
**C:** How often to do the AP selection?
**A:** In STA driven AP selection, the STA can do as it likes.

**Recess.**

**Tuesday 16 July 2019, AM1 Session**

**Introduction**

1. The Chair calls the meeting to order at 8:01 AM. Around 100 people in the room.
2. The Chair reminds the group about the procedures.
3. The Chair asks for any potentially essential patents. Nobody speaks up.
4. The Chair goes through the presentations of the day. The agenda document of the day is 11-19/0986r5. Today we will have PHY presentations. Agenda:
	* Call meeting to order
	* IEEE-SA IPR policy and Procedure
	* Presentation of submissions
	* Recess
5. The attendance server is down, so we will take manual attendance as a backup.

**Submissions**

1. 11-19/0797r1, “320 MHz Channelization and Tone Plan” – Bin Tian (Qualcomm)

**Summary:** They claim that gains from 320 MHz are: double the peak throughput, but also improve rate vs range due to linear BW vs log SNR. There are contiguous and non-contiguous possibilities for the channelization. Specifics on the tone plans are presented.

**C:** Whether we want a brand new SU tone plan for 320 MHz? Do you consider any other BWs such as 240 MHz contigueous?
**A:** Lets wait with the discussion regarding tone plan for 320 MHz. Regarding the 240 MHz tone plan, we have not discussed it yet. We probably need more discussion before we agree on that.
**C:** There is multi-link on the MAC side. How does that work with this tone plan?
**A:** I believe the multi-link is separate from this part. Exactly how to do this I believe we need to think more about it.
**C:** On slide 6, what is the difference between the green and purple?
**A:** The tone plan is slightly different for MU tone plans compared to SU tone plans. So we inherit these differences.

**Straw poll 1:** Do you support adding 320 MHz and 160+160 MHz PPDUs to 11be?
**Result:** Yes/No/Abstain: 61/0/13

**Straw poll 2:** Do you support that 11be uses the same subcarrier spacing for the data portion of EHT PPDU as 11ax data portion?
**Result:** Yes/No/Abstain: 70/0/10

**Straw poll 3:** Do you support the following EHT tone plans?
– Reuse 11ax tone plan for 20/40/80/0160/80+80 MHz
– 320 MHz and 160+160 MHz use duplicated HE160 for OfDMA tone plan

Note: puncturing design TBD. Non-OFDMA 320 MHz/160+160 MHz tone plan TBD

**Result:** Yes/No/Abstain: 42/0/37
2. 11-19/1066r0, “Tone Plan Discussion” – Eunsung Park (LG Electronics)

**Summary:** They propose two new tone plans: 320 MHz and 240 MHz. They propose to reuse the 11ax OFDMA tone plans. For the contiguous BW, they propose new tone plans.

**C:** So you propose to introduce a new tone plan, that requires some added complexity.
**A:** How much complexity is really added?
**C:** I agree that we should come up with new tone plans.
**A:** Ok.
**C:** We have to ask ourselves what is the benefit of defining these contiguous tone plans compared to the 160+160 MHz tone plans.
3. 11-19/0833r0, “SOMA Updates” – Junghoon Suh (Huawei)

**Summary:** They claim that the benefits from SOMA comes from that performance loss by the split power resource is smaller than the performance loss by the split BW. SOMA requires a new constellation mapper. They claim SOMA provides better system performance compared to OFDMA.

**C:** Did you do the simulations with beamforming?
**A:** No. I doubt SOMA will work well with beamforming.
**C:** I don’t believe this scheme is appropriate for Wi-Fi.
**A:** Ok.
4. 11-19/1099r0, “Preamble Structure” – Ross Jian Yu (Huawei)

**Summary:** They claim that L-preamble is needed in at least one mode of EHT PPDU. They claim several aspects that need to be considered for EHT auto detection. They believe that more signalling bits are likely needed.

**C:** On slide 6. What do you mean with a sequence masked L-SIG.
**A:** You have some mask sequence multiplied to the L-SIG.
**C:** On slide 8. You say that signalling field needs to be more efficiently. What do you mean by 40 MHz or larger unit?
**A:** Instead of using duplicated SIG on 40 MHz we can have a single SIG over 40 MHz BW.
**C:** I don’t understand how this 40 MHz would work? Because we need to preserve 20 MHz operation.
**A:** We will present more details in follow-up presentations.
5. 11-19/1142r0, “Discussion on the preamble for 11be” – Dongguk Lim (LG Electronics)

**Summary:** They believe EHT packets should be differentiated from previous amendment packets as early as possible. They propose several options how to do this.

**Straw poll 2:** Do you agree that for the range extension, RL-SIG is used in 11be PPDU?
**Result:** Yes/No/Abstain: 15/0/many (~50% in the room)
6. 11-19/1190r0, “Improved Preamble Puncturing in 802.11be” – Oded Redlich (Huawei)

**Summary:** They claim preamble puncturing may be improved compared to 11ax. They propose a more dynamic puncturing which they believe significantly increases channel utilization.

Straw poll 1: Do you support in adding Preamble Puncturing improvements in MU-PPDU to 802.11be?

**C:** I believe we need more detailed straw polls. I believe it may be too broad.
**C:** I’m a bit confused about if we want to improve the MU-PPDU, or the SU-PPDU or both…

**Result:** Yes/No/Abstain:

-- out of time

**Recess**

**Tuesday 16 July 2019, EVE Session**

**Introduction**

1. Alfred Asterjadhi (Qualcomm) and Janosh Farkas (Ericsson) calls the meeting to order at 7:32 PM.
2. Alfred asks if there are any potentially essential patents. Nobody speaks up.
3. Around 175 people in the room.
4. Agenda:
	* Joint meeting with IEEE 802.1 TSN
	* Call meeting to order
	* IEEE-SA IPR policy and Procedure
	* Introduction
	* Useful Reads
	* Presentation of submissions
		1. 19/1298-IEEE 802.1 TSN - An introduction (Janos Farkas) [25mins]
		2. 19/1266-Wireless + TSN = part of the picture (Norman Finn) [25mins]
		3. 19/1287-TSN support in 802.11 and potential extensions for TGbe (Dave Cavalcanti) [25mins]
		4. 19/1223-Improving WLAN reliability Joint TSN-11be session (Antonio De La Oliva Delgado) [15mins]
	* Next Steps
	* Recess
5. Any objection to approve the agenda. No objection. Agenda approved by unanimous consent.

Presentations

1. 11-19/1298r1, “IEEE 802.1 TSN – An Introduction” – Janosh Farkas (Ericsson)

**Summary:** TSN is a toolbox which is getting richer. A TSN profile is a set of tools required for some certain use-case. There are bridges and end-points (talker and listener). 802.1Qbv has time-gated queues with a periodically repeated time schedule – time synchronization is needed. 802.1Qci protects against bandwidth violation, malfunctioning, attacks, etc.. P802.1Qcr zero congestion without sync – basically reclassifies packets into the correct queues. 802.1CB – replication and elimination for reliability: send duplicates on disjoint paths. 802.1Qcc handles the configuration of TSN (distributed, centralized, etc).

**C:** In 802.11 when a packet fails. How does that work with the time critical data.
**A:** I don’t know the answer on this. We have focused on deterministic media, in 802.1 we assume comes from.
**C:** In 802.1Qbv only guarantees that data is not transmitted when the gate is closed.
**C:** The characteristic of different media is different. We may need to revisit some assumptions. In a wired network, you typically don’t have a lot of changes in the network. In the 802.1 model, we model the queue of streams. I believe the discussion of retransmissions belongs to the MAC layer rather than the bridging layer.
**C:** In the end of the day we need a higher layer API (let’s call it TSN), and we have to solve the problem of providing what is required.
**C:** What about the transport layer?
**C:** We have worked very hard that hardware has the necessary functionality.
**C:** On slide 8, what is the protocol between SDN and 802.1?
**A:** The very basic definition by SDN is the separation between control planes.
**C:** On slide 12, do you reclassify the packets? How does that work for different protocols?
**A:** The point with IPV is to beyond the capability of the IPC. Furthermore we have a standard (802.1CB) that goes into the TCP headers and peeks.
**C:** Let’s say you enter the TSN with IPV classification and then go through several bridges. How can you guarantee that the classification remains.
**A:** It is not ideal to do it in every hop. The basic approach is that we use layer 2 header fields. It can be a relay tag. There are multiple solutions for relay tagging.
**C:** Slide 11, we have seen similar things in WNG and such. We have this idea in 802.11 that packets should be hammered out as soon as possible. But now you spark the idea that some packets can be held back to the appropriate time.
**A:** The goal is to assure 0 congestion loss. So it is absolutely necessary that you do not transmit as soon as possible. We need bounded latency, not necessarily the lowest possible. You want to transmit packets at the same average rate at every hop.
**C:** I believe it becomes increasingly important with right time packet delivery instead of as soon as possible time delivery. I believe we can make networks that are more energy efficient in such way.
2. 11-19/1266r1, “Wireless + TSN = part of the picture” – Norman Finn (Huawei)

**Summary:** The application requires end-to-end QoS over wired+wireless+bridges+routers+etc network. Real time application require latency limit and low (no) lost packets. A definition: “Minimize the packet loss rate, given an absolute upper bound on end-to-end latency”. Congestion management is not an option. They want to reserve the throughput before we send the data. With very low packet error rate, designing real time applications becomes much much easier (compared to a non-negligible packet error rate). They believe we should talk about bounded packet loss for bounded latency. They think we should avoid creating the wired vs wireless competition. Send/ack/resend is a tradeoff with latency and packet loss. They say a faraday cage may enable TSN to be used directly with 802.11 and already this may solve the problem many users have. They think that TSN/DetNet needs to consider the 1% PER case while 802.11 needs to consider the value of the 0% PER case.

**C:** You mention real time application that some people are already writing the application. What kind of API are they using?
**A:** Ultimately you can imagine that you configure the socket on your real time requirements. But we haven’t really gone into this in the standardization.
3. 11-19/1287r1, “TSN support in 802.11 and potential extensions for TGbe” – Dave Cavalcanti (Intel)

**Summary:** They believe admission control is required, network be provisioned. If you cannot manage the network you cannot guarantee anything. A use-case example can be the industrial control system. They believe the main gaps we need to fix are the latency and reliability parts. For time synchronization we have the FTM protocol. They believe a scheduled operation, for example a trigger based access. They think Multi-AP operation can leverage the managing by having a master AP coordinating other APs. They have listed enhancements needed for TSN-grade bounded latency: time-sensitive traffic identification, scheduled operation for time-sensitive traffic, traffic isolation mechanisms, Multi-AP resource coordination across managed OBSSs. Their idea of additional TSN capabilities: low latency is important, but reliabilitiy is equally important, once latency and reliability is met, maximize throughput. Frame pre-emption could be considered for 802.11.

**C:** On slide 18, the AP probably needs to sacrifice the capacity for latency.
**A:** Agreed.
**C:** One question regarding the managed network, how do you define it?
**A:** In this case the BSSs are managed by the same entity.
**C:** In your simulations how did you do it?
**A:** With AP trigger based scheduling.
4. 11-19/1223r0, “Improving WLAN reliability” – Antonio de la Olivia (InterDigital, UC3M)

**Summary:** The need for ultra high reliability. Reliability issues in wireless comes from collisions and radio impairments 🡪 normally not problems in 802.3. Retransmissions (time diversity) and rate adaptation is used to combat these.

**Question from the chair(s) about steps forward.
Alfred:** We are currently very early in the TG process.
**Janosh:** It would be great if TGbe comes up with ideas and coordinate with us in 802.1.
**C:** Maybe we need to collaborate on the overall architecture.
**Alfred:** You mean like signalling between the different layers?
**C:** Yes.

**Recess.**

**Wednesday July 17, AM1 Session**

**Introduction**

1. The Chair calls the meeting to order at 8:01 AM. Around 150 people in the room. Agenda 11-19/0986r8.
2. The chair asks the group about potentially essential patents. Nobody speaks up.
3. Agenda:
* Call meeting to order
* IEEE-SA IPR policy and Procedure
* Presentation of submissions
* Recess

**Presentations**

1. 11-19/0764r1, “Multi-Link Aggregation: Peak Throughput Gains” – Abhishek Patil (Qualcomm)

**Summary:** They claim increased spectral efficienty, increased peak throughput, enables frameworks for control channel/data channel separation. They provide simulation results showing interesting benefits.

**C:** Slide 5, do you have many scenarios?
**A:** Yes. **C:** I understand this is a MAC simulation with no PHY aspects?
**A:** Yes that’s correct.
**C:** How do you think will change when we have a full PHY simulation? For example do you have retransmission?
**A:** Here, we don’t do that?
**C:** I see this as upper bound of what we can achieve?
**A:** Yes.
**C:** Are the link capacity is the same? What happens when the links are very unbalanced?
**A:** We haven’t simulated this, but we can try it if you like.
**C:** What do you mean by peak throughput?
**A:** It means what is the throughput what the client perceives.
**C:** I think average throughput makes more sense than peak.
**A:** Ok.
2. 11-19/0773r1, “Multi-link Operation Framework” – Po-Kai Huang (Intel)

**Summary:** They believe we need a definition of multi-link logical entity. They talk further on the model. The point is to provide a model where multi-link functionality is abstracted away for upper layers.

**C:** On slide 7, are you talking about things like association?
**A:** As a first step we want to connect to the existing framework. We need further discussion.
**C:** Can you give a good comparison to FST which is there today? Request to allow my presentation on FST before straw poll.
**C:** It is not clear to me how to determine if I belong to a logical entity or not.
**C:** A single physical STA can be connected to two physical APs simultaneously based on this terminology. Is this correct?
**A:** Such an aspect is not part of the model.
**C:** Can you go to slide 10. You enable class 2 and class 3 frame exchange.
**A:** This is not part of straw poll, we can discuss offline.
**C:** Slide 11. Also not part of straw poll.

**Straw poll #1:** Do you support the following definition:
- Multi-link logical entity: A logical entity that has one or more affiliated STAs. The logical entity has one MAC data service interface and primitives to the LLC and a single address associated with the interface, which can be used to communicate on the DSM.
- Note – A multi-link logical entity allows STAs affiliated with the multi-link logical entity to have the same MAC address.
- Note – The exact name can be changed.

**C:** This is the first time we see the straw poll so I believe we need to postpone it.
**C:** I think we should remove the reference to presentations.
**C:** In the definition, can you remove logical?
**A:** I don’t want to touch the name.

**Result:** Yes/No/Abstain: 54/17/many (~75)
3. 11-19/0810r1, “Discussion on 6 GHz band support” – Yusuke Tanaka (Sony)

**Summary:** Currently, FCC is the only entity that has allowed 6 GHz usage as ISM. The spectrum in 6 GHz band is of great benefit to 802.11be. They observe that under the proposed rules only 29%, and no contiguous 320 MHz section, of the 6 GHz band is available without database access. They say we need to develop database access capability as a key functionality in .11be.

**C:** The TGax have also discussed 6 GHz operation. They somehow concluded that no database is needed. What additional features do you believe is needed to TGbe. And if so, maybe this discussion then should go to another TG.
**A:** I believe this is a good chance to develop this inside the TGbe.
**C:** So you don’t need the GDD for the US market, but for the European market.
**A:** I believe the architecture can be reuse, as a basis to start the discussion.
**C:** Regarding the typical IEEE behaviour we have the time to market issue. Why do we want to spend effort on something that I believe will not be used by the industry?
**A:** It is not realistic to obtain all the gains in TGbe without addressing this.
**C:** 6 GHz is already available for TGax, if we have to do something for TGbe, meaning the 6 GHz operation in TGax is insufficient, which is a message we don’t want to send. Therefore, I believe it is too late to address this in TGbe. I also believe using TGaf as a reference is not accurate.
**A:** For the first comment, I believe we should consider the phase of the spec that TGbe is now in the initial phase of specification.
**C:** For 6 GHz it is not finalized yet, so maybe we don’t need to take all from slide 12. I believe it is a bit premature for us to take a decision on this.
**A:** Ok.

**Straw poll #1:** Do you think that TGbe may need to consider the NRA proposed rules such as database access requirements and so on to support the entirety of the 6 GHz bands?

**Result:** Yes/No/Need more information: 28/3/many (~100)
4. 11-19/0824r3, “Multi-link Operation Performance” – Sharan Naribole (Samsung)

**Summary:** They have done some simulations on multi-link operation. It seems a conclusion is that single link 160 MHz provides similar results as multi-link uniform in terms of throughput. But best latency is obtained by multi-link dedicated.

**C:** It’s hard to get any conclusion from the results. What is the best?
**A:** This is a very specific network scenario where there is no OBSS load. I do this as a first test to build up understanding.
**C:** I also noticed you have fixed MCS5. Why this MCS? It doesn’t seem very realistic.
**A:** I’m not focusing on the peak throughput, and I want to do fair comparisons.
**C:** Slide 3, why did you consider common queue architecture? What happens is that you may get stuck on a link.
**A:** This was more out of simplicity as a first step.
**C:** Slide 7, why is the latency for the dedicated less than the uniform?
**A:** Because of the round-robin scheme.
**C:** Then I’m wondering what are you actually trying to model in the end?

-- time out!

**Recess**

**Thursday July 18, AM1 Session**

**Introduction**

1. At 8:01 PM, the Chair calls the meeting to order. Around 125 people in the room.
2. Procedures.
3. Call for potentially essential patents. Nobody speaks up.
4. The agenda:
	* Call meeting to order
	* IEEE-SA IPR policy and Procedure
	* TG Documents
	* Presentation of submissions
	* Recess
5. No objections to approve the agenda.

**TG Documents**

1. 19-11/719, “TGbe channel model document” – Jianhan Liu (Mediatek)

**Summary:** Minimal changes compared to the channel models used previously.

**C:** Do you think we should consider adding/increasing the doppler model? Considering handhelds etc.
**A:** In TGax we already updated the doppler model for the UMi and UMa. You can use that doppler model for indoor.

**Motion:** “Channel Model Motion”

Move to accept 19/0719r1 as the channel model document for TGbe.

**Discussion:**
**C:** What are we going to use this document for?
**A:** We can use this document for simulations etc.
**C:** It only makes sense to me to have this document if we have a methodology document.
**C:** I believe we can use the evaluation document in TGax can be used.
**C:** I think we need to talk about use-cases. I am concerned that we haven’t done any efforts for the TG documents. Especially for multi-AP we see a lot of people taking different approaches for the evaluation. And I do believe this document as standalone is not very useful.
**C:** The motion text looks like a final decision. There is no room to revise it.

**Move:** Jianhan Liu (Mediatek) Second: Wookbong Lee (LG Electronics)

**Discussion:
C:** I am concerned that the document seems final.
**A:** Any document can always be amended.

**Result:** Motion approved with unanimous consent.
2. 11-19/0722r1, “Proposed TGbe Functional Requirements” – Ming Gan (Huawei)

**C:** Maybe it is better to group the R1, R2, … numbering within the section?
**A:** I don’t think this is necessary.

**Motion:** “Functional Requirements Motion”

Move to accept 11-19/722r1 as the functional requirements document for TGbe.

**Move:** Ming Gan (Huawei) **Second:** Po-Kai Huang (Intel)

**Discussion:
C:** I am concerned that the document seem final.
**A:** Any document can always be amended.

**Result:** Motion approved with unanimous consent.

**Submissions**

1. 19/792r2, “Comparinsons of HARQ transmission schemes for 11be” – Yan Zhang (Marvell)

**Summary:** Use puncturing to modify code rate. They have performed simulations. They can increase the HARQ-CC performance gain from about 1.3 dB gain to 2.5 dB gain with puncturing. MCS selection based on SNR may provide PER of 10%-40%. They provide tables that shows a larger gain for their scheme compared to ARQ at high PERs. As for the memory requirement, after two transmissions, they claim that almost all codewords are correct.

**C:** There is a severe issue with alignment between codewords and MPDUs. We have to take this into account. I think if you take the average codeword errors your results may improve.
**C:** Codeword based simulation is not a good way.
**A:** I agree, I simulated this because many other companies have done that.
**C:** On slide 8, when you do the IR, you use rate ½ and you puncture? So if you want to create a rate 2/3 code you use the rate ½ and puncturing. Do you compare with the standard 2/3 or this code?
**A:** Yes.
**C:** I don’t think the discussion with codeword and feedback is not fair. So you should do codeword feedback with both HARQ and MPDU.
**C:** Slide 23, what do you mean with the mapping between codewords and MPDUs
**A:** We need the mapping.
**C:** What’s the rule for the puncturing.
**A:** I didn’t optimize it.
**C:** From the first, second, to third, the requirements have reduced. Maybe the retransmissions don’t come in order.
**A:** You can have TXOP to protect it.
2. 11-19/798r0, “HARQ Simulation Results” – Ron Porat (Broadcom)

**Summary:** They also have erroneous feedback in some simulations. LDPC codeword based feedback. For the SU BF results, the CC does not provide much feedback over ARQ, but IR looks better. They believe CC provides too small gains to be interesting, but IR may be interesting.

**C:** For the MU-MIMO result, if result is good, how do we do it?
**A:** We only care about one user, the other user is just part in the precoder calculation.
**C:** So SSs do not change?
**A:** Correct.
**C:** Do you have that the retransmission is self decodable.
**A:** I didn’t provide these details. But we have 4 different code rates. So we transmit parity bits in the retransmissions. So they are not self decodable.
**C:** I agree with your results and conclusion. Maybe we can optimize the IR scheme.
**A:** We are open to it.
**C:** On slide 6, what are your views on MU-MIMO. How would you do MU-MIMO together with HARQ.
**A:** Yes, if we end up supporting HARQ, we would like to support MU-MIMO.
3. 11-19/0873r1, “HARQ Framing” – Imran Latif (Quantenna)

**Summary:** HARQ at A-MPDU level is extremely inefficient in terms of resources 🡪 Needs changes at MAC. HARQ at CW level they present two solutions: MAC layer figures failed MPDUs which are signalled to the PHY, which then needs to ask for the corresponding CWs. PHY can determine that CW fail based on LDPC parity and we can do dual feedback.

**C:** Slide 11, in this example if only CW-3 and CW-6 failed, what happens.
**A:** Only retransmit those CWs.
**C:** The question is if the parity check matrix. Can we use this to confirm the CW correctness when we do puncturing? I think we need to evaluate.
**A:** That’s why we have the MAC information also.
**C:** You only base on LDPC code. How do you do with BCC?
**A:** We haven’t looked at that.
**C:** Slide 16, what does it mean?
**A:** That you aggregate the retransmission CWs with the next transmission.
**C:** Even if only CW-3 and CW-6 is in error, you actually need to store CW-4 and CW-5.
**A:** I disagree.
**C:** Because you do the search in the MPDU, you don’t need to maintain MPDU-1 and MPDU-3, since they are already checked.
**C:** Just a clarification, the retransmission CW could be very short.
**A:** Yes.

**Recess.**

**Thursday July 18, PM1 Session**

**Introduction**

1. At 1:31, the Chair calls the meeting to order. Around 175 people in the room.
2. The Chair reminds about policy.
3. The Chair asks about potentially essential patents. Nobody speaks up.
4. Agenda:
	* Call meeting to order
	* IEEE-SA IPR policy and Procedure
	* Presentation of submissions
	* Teleconference Plan
	* Goals for September 2019
	* Any other business
	* Adjourn
5. Agenda approved with unanimous consent.

**Submissions**

1. 11-19/0828r4, “ Feedback Overhead Analysis for 16 Spatial Stream MIMO” – Hanqing Lou (InterDigital)

**Summary:** They claim that new designs for sounding feedback is needed to support up to 16 SS.

**TG Documents**

1. 11-19/1262r1, “Specification Framework for TGbe” – Edward Au (Huawei)

**Summary:** This is a draft document. It closely resembles the template used for TGax.

**C:** Will you add/remove sections depending on the group needs.
**A:** Yes.
**C:** You have the term candidate features, but in the SFD there should only be features, no “candidate”.
**A:** Yes, agreed.

**Motion:** Specification Framework Motion.

Move to accept 11-19/1262r2 as the baseline specification framework document for TGbe

**Move:** Edward Au (Huawei), **Second:** Srinivas Kandala (Samsung)

**Result:** Motion approved with unanimous consent.

**Submission**

1. 11-19/0832r0, “Performance Evaluation of 16 Spatial Stream based MU-MIMO” – Junghoon Suh (Huawei)

**Summary:** They have performed simulations. They claim that performance drops unless a certain detection scheme such as MLD with interference whitening is used in the receiver.
2. 11-19/1018r1, “Feature overhead reduction” – Wook Bong (Samsung)

**Summary:** Shows pros/cons for explicit feedback and implicit feedback. They claim that performance of implicit feedback is bounded by uplink channel. Good calibration is required. They propose an overhead reduction scheme, where feedback overhead of 16 antennas is like that of 8 antennas.
3. 11-19/1115r0, “Reduced Beamforming Feedback for 802.11be” – Genadiy Tsodik (Huawei)

**Summary:** They have tried a wideband precoder. Mixed beamforming may be an alternative. The mixed beamformer performs almost as good as per-tone precoder. Wideband precoder requires significantly less complexity than per tone (for many tones).

**C:** Did you consider smaller bandwidth for the wideband precoder?
**A:** Yes, I did some simulations and yes it may be performing worse in narrow band.
**C:** Have you evaluated higher SNR, where you may have more degradation.
**A:** I did simulation up to MCS7, and there is some degradation in higher MCS.
**C:** So your idea is to modify the grouping number?
**A:** Yes.
**C:** This has nothing to do with analog beamforming, right?
**A:** Actually I mention that wideband precoder is in some sense a digital implementation of analog beamforming.
4. 11-19/1268r0, “Implicit sounding overhead analysis” – Sigurd Schelstraete (Quantenna)

**Summary:** They list the current compressed beamforming frame information. They have derived the amount of information required in the compressed feedback for 16 spatial streams. Furthermore, they look at implicit sounding. Other considerations include power differences between UL and DL powers. They observe that MU (OFDMA) does not always provide significant improvements for high-dimensional cases. They also say that MU-type feedback is not the ultimate solution for reducing sounding overhead. They show that implicit sounding scales much better than explicit sounding. They propose an optional sounding mechanism for reducing sounding overhead.

**C:** When you compare the durations between implicit and explicit. UL/DL power asymmetry together with calibration and other aspects may significantly change the outcome.
**A:** You are correct that the results will change, but I don’t believe it will be a significant differenc. There is a depate about how often you must do the calibration. I am not sure it will affect the airtime, but the complexity.
**C:** You repeat the LTF 4 times to make up for a difference of 6 dB.
**A:** There is plenty of margin.
**C:** What MCS did you use for these bars?
**A:** 2.
**C:** I think you have to use MCS4 for a fair comparison.
**A:** I disagree.
**C:** I strongly disagree with your results. Another point is that we have this already in TGax, we don’t need anything new.
**A:** The way it is specified in TGax is that the STAs can apply any precoder they want, and thus we cannot estimate the channel.
**C:** I disagree.
**C:** I really encourage you to do some simulations for implicit beamforming. Because our simulations show that implicit beamforming for MU does not work.

**Outroduction**

1. Telephone conference plan. 7 telephone conferences planned. The Chair asks if the group is willing to extend the conference time to 2:30 (hh:mm).

**C:** I think we need an ad-hoc group for next September meeting.
**C:** I have made my reservation already for the travel.
**C:** I believe this is invalid comment since we have to make these decisions in the F2F.
**The Chair:** I have requested 10 slots for the September meeting.

The telephone conference plan approved.

**Straw poll #1:** Do you prefer to have an ad-hoc prior to September F2F on Sunday?

**C:** In the past when we discussed ad-hoc, conference rooms are hard. Do we have that?
**A:** If the straw poll is positive I will check with the leadership.

**Result:** Yes/No: 23/many

**Adjourned**