IEEE P802.11  
Wireless LANs

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| Minutes for Task Group (TG) 802.11 be Extremely High Throughput Telephone Conferences in February and March 2020 | | | | |
| Date: 2020-02-13 | | | | |
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Abstract

This document contains the meeting minutes from TGbe telcos in February and March, 2020.

* Rev0: Added meeting minutes for Thursday February 6.
* Rev1: Addition of minutes for conference all of Thursday February 13, 2020.

**Thursday 6 February 2020, 10:00 – 12:00 ET**

**Introduction**

1. At 10:00 the Chair Alfred Asterjadhi (Qualcomm), calls the meeting to order.
2. The Chair goes through the IPR policy and procedures. The Chair asks if anyone is aware of any potentially essential patents. Nobody speaks up.
3. The chair reminds to take attendance through an e-mail to the Secretary, Dennis Sundman (Ericsson), or the Chair. According to the join.me application, it appears to be around 100 people on the call.

Registered through e-mail:

* 1. Alfred Asterjadhi (Qualcomm)
  2. Dennis Sundman (Ericsson)
  3. Gaurav Patwardhan (HPE)
  4. Kazuto Yano (ATR)
  5. Kiran Uln (Cypress)
  6. Kosuke Aio (Sony)
  7. Ross Yu (Huawei)
  8. William Carney (Sony)
  9. Yusuke Tanaka (Sony)

1. Announcements: The Chair informs about the MAC ad-hoc. It is TBD if the meeting will start at 8:00 or 9:00 AM. Currently no restriction due to the Corona virus. The Chair asks if there are any questions regarding the ad-hoc. There will be a join.me, or similar, for the ad-hoc.
2. The next item on the agenda is technical submissions. The Chair asks if there is any objection regarding the grouping of the technical submissions. No objection noted.
3. The chair asks if there is any objection to approve the agenda. Nobody objection noted.

**Technical Submissions**

1. [**0035r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0035-00-00be-discussion-on-expansion-of-multi-link-aggregation-to-multi-ap.pptx)**, “Discussion on Expansion of Multi-Link Aggr. to Multi-AP” – Yoshihisa Kondo (ATR)**

**Summary:** The authors discuss how Multi-Link can be combined with Multi-AP. They claim this may be of large interest for real-time applications.

**Discussion:**

None.

1. [**0068r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0068-00-00be-multi-link-and-multi-ap-reference-model-discussion.pptx)**, “Multi-link and multi-ap reference-model discussion” – Yonggang Fang (ZTE)**

**Summary:** The authors present new reference models supporting both multi-link and multi-ap.

**Discussion:**

C: On slide 7. The shared AP only borrows TXOP. I am confused about this diagram.

A: A shared AP has 2 or multiple communication links.

C: On slide 7. Are you assuming the APs are co-located?  
A: The APs may be either co-located or not.  
C: Do you need any synchronization between the different transmission modes?

A: That depends on the implementation.

1. [**0032r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0032-00-00be-consideration-on-multi-ap-home-mesh-scenario.pptx)**, “Consideration on Multi-AP Home Mesh Scenario” – Kosuke Aio (Sony)**

**Summary:** The authors propose a new residential reference scenario to evaluate home mesh scenarios.

**Discussion:**

C: Using RTS/CTS is common practice. How come you have not used it?  
A: We have not used that here.  
C: Are you mostly focusing the 3 APs at home, or are you also considering interference from APs in other homes?  
A: Currently I haven’t considered APs in other homes because I want to look at a simple case.

C: What is your thought for the enterprise and hot-spot scenario regarding multi-AP operation?  
A: They may be fine, but for this presentation, we focused on the residental one.

1. [**0064r1**](https://mentor.ieee.org/802.11/dcn/20/11-20-0064-01-00be-overview-of-multi-ap-operation-in-11be.pptx)**, “Overview of Multi-AP Operation in 11be” – Chenhe Ji (Huawei)**

**Summary:** The authors take a large view over multi-AP operation. To support all things that we have discussed, they argue that much work still needs to be done. Therefore they suggest to begin looking at non-AP STAs functionality.

**Discussion:**  
None.

1. [**0033r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0033-00-00be-coordinated-spatial-reuse-operation.pptx)**, “Coordinated spatial reuse operation” – Jason Yuchen Guo (Huawei)**

**Summary:** The authors propose that coordination may be used to perform good power control. They present a transmission procedure and gives some examples.  
  
**Discussion:**C: Can you go to slide 8. If AP1 wins the TXOP, that needs to be communicated to AP2, is that right?  
A: Yes.  
C: If one AP is doing downlink, does the other AP also do that?  
A: Yes.  
C: Slide 9. You assume a wireless backhaul, right?  
A: I am not sure. There can be some wired backhaul.  
C: Slide 5. There are lots of AP-AP communication in this slide. Are you planning that all this AP-AP signalling to be specified in the specification?  
A: Yes.

C: How is this different from SRP?  
A: The SRP scheme is a distributed one. This is coordinated.

**AoB:** No other business noted.

**Adjourned at 11:55.**

**Thursday 13 February 2020, 19:00 – 22:00 ET**

**Introduction**

1. At 19:05 the Chair Alfred Asterjadhi (Qualcomm), calls the meeting to order.
2. The Chair goes through the IPR policy and procedures as found in document 11-20-0240-06-00be-ASDFASDF. The Chair asks if anyone is aware of any potentially essential patents. Nobody speaks up.
3. The chair reminds to take attendance through an e-mail to the Secretary, Dennis Sundman (Ericsson), Vice Chair Matthew Fischer, or the Chair. According to the join.me application, there are 138 connections to the joinme app.

Names identified either through the participant list of joinme, or through the receipt of an email, or through self identification during the call:

* 1. Alfred Asterjadhi (Qualcomm)
  2. Matthew Fischer (Broadcom)
  3. Johnathan Segev (Intel)
  4. Dibakar Das (Intel)
  5. Dmitry Akhmetov (Intel)
  6. Dorothy Stanley (HPE)
  7. Guarav Patwardhan (HPE)
  8. Hirohiko Inohiza (Canon)
  9. Jinsoo Choi (LGE)
  10. Frank Hsu (Mediatek)
  11. Gnadiy (Huawei)
  12. Junghoon Suh (Huawei)
  13. John Yi (xxxx)
  14. Namyeong Kim (LGE)
  15. Myeongjin Kim (Samsung)
  16. Rojan Chitrakar (Panasonic)
  17. Ron Porat (Broadcom)
  18. Sang Kim (LGE)
  19. Sigurd Schelstraete (Quantenna, On)
  20. Jarkko Knecht (Apple)
  21. Steve Shellhammer (Qualcomm)
  22. Taewon Song (LGE)
  23. Al Petrick (Interdigital)
  24. Ross Yu (Huawei)
  25. Shimi Shilo (Huawei)
  26. Tomo Adachi (Toshiba)
  27. Jianhan Liu (Mediatek)
  28. Yan Xin (Huawei)
  29. Yonggang Fang (ZTE)
  30. Young Hoon Kwon (NXP)
  31. Yujin Noh (Newracom)
  32. Yunbo Li (Huawei)
  33. Yusuke Tanaka (Sony)
  34. Feng Jiang (Intel)
  35. Wookbong (Samsung)
  36. Rui Yang (Interdigital)
  37. Chunyu Hu (Facebook)
  38. ?Kazuto Yano (ATR)
  39. ?Kiran Uln (Cypress)
  40. ?Kosuke Aio (Sony)
  41. ?William Carney (Sony)

1. Announcements: The Chair provides the following information about the MAC ad-hoc:
   1. It will be held in Santa Clara, hosted by Intel
   2. There are US entrance restrictions due to the Coronavirus
   3. March 13, 09:00 – 18:00
   4. There will be a webex connection
   5. The Chair asks if there are any questions regarding the ad-hoc, there are none.
2. The next item on the agenda is technical submissions. The Chair asks if there is any objection regarding the listing and ordering of the technical submissions as proposed within xxxxx.
   1. No objection noted.
3. The chair asks if there is any objection to approve the agenda.
   1. Nobody objected.

**Technical Submissions**

1. [**0073r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0073-00-00be-on-coordinated-spatial-reuse-in-11be.pptx)**, “On Coordinated Spatial Reuse in 11be” – Jianhan Liu (Mediatek)**

**Summary:** The authors discuss the extension of existing Spatial Reuse to Coordinated Spatial Reuse which operates among a set of Aps, with simulated comparisons to coordinated OFDMA, spatial reuse (blind), spatial reuse using TPC, 11ax spatial reuse.

**Discussion:**

Q: Is this UL sim?

A: yes, no, DL, did not simulate UL

Q: How is power control performed?

A: AP sends a trigger to other APs to coordinate by examining pathloss

Q: How does each AP know the location of interferers?

A: each AP needs to know, each STA needs to report, other STA will report, so 2 pathloss numbers are known and then a calculation can be made

Q: to coordinate, need to schedule ahead of time

A: yes, need to exchange pathloss information

Q: how to calculate MCS?

A: based on pathloss during multiple transmissions, assuming no beamforming, omni assumed, STA calculates SINR based on presence of overlapping signal, calculates effective MCS possible, throughput determined based on that

Q: APs will send at the same time, then calculate SINR, then determine MCS

A: selection of optimal TX power, a search between many AP power combinations is performed, then power is chosen to yield highest overall throughput, in our simulation, we search for the best result

Q: what is the difference between SR and OBSS PD?

A: SR is no power control, every AP at max power, OBSS PD adjusts the threshold based on TX power, not interesting to include this

Q: what difference would there be if you had a realistic MCS adaptation?

Q: slide 6, configurations, if AP1 gains the medium, what if there is a STA transmitting to AP4 when AP1 wants to transmit?

A: that’s a natural spatial reuse event, no coordination needed, but in this slide, the AP-AP distance is only 40 meters, so your case should not occur in this configuration

Q: slide 7, coordinated OFDMA case, showing a straight line, each BSS has the same size RU, each AP will have the same, max MCS?

A: yes, it behaves the same as one AP with one STA per BSS, preamble not considered, SNR is always enough for highest MCS, configuration 3, the BSS radius is larger, and COFDMA is no longer a straight line

Q: slide 10 is also still almost straight, still high MCS?

A: yes, still very high MCS

Q: what sort of PPDUs? SU, or MU, DL?

A: AMPDU, SU

Q: except for the COFDMA

A: even for COFDMA, single user per RU

Q: multi-AP case, SU or MU?

A: always only SU in the simulations, but MU should have a similar result, assuming that each AP in multi-AP, each AP is TX to a different user

Q: not practical STA configurations, configuration 4 or 5, difficult to achieve this in real life

A: we just show that there are always gains, regardless of the configuration, might do better when a STA is close to the AP, for example

Q: random associations to the different APs might produce a different result

A: configuration 2 and 3 do this

Q: beamforming – you simulated only omni, what would happen with beamforming without coordination, each AP would potentially have less interference to other transmissions

A: we have those results, but in that case, the result would be inbetween the CBF and omni, coordinated BF outperforms coordinated SR, uncoordinated beamforming will help, we have those results as well

Q: agreed to have a two release approach in last meeting, with a single simple coordinated AP mechanism, would this meet that goal?

A: yes, this is simple, CSR is simpler than COFDMA and better gains, believe that it is suitable for wave one

No straw poll

1. [**0107r1**](https://mentor.ieee.org/802.11/dcn/20/11-20-0107-01-00be-multi-ap-coordination-for-spatial-reuse.pptx)**, “Multi-AP coordination for spatial reuse” – Dmitry Akhmetov (Intel)**

**Summary:** The authors present a proposal for coordinated spatial reuse between two APs and associated STAs.

**Discussion:**

Q: any UL?

A: no – only DL, same mechanism can be applied for UL

Q: assume completely controlled, no EDCA?

A: yes, a bit extreme

Q: contention is still present, but when an AP wins, it can perform CSR

Q: would it be possible to do both DL and UL within a CSR time period?

A: the exchanges should be symmetrical

Q: slide 4, is there Carrier sensing within the SIFS, if so, what happens when busy?

A: did not have Carrier sense in the simulation, if an invited AP does not transmit, then so be it, winning AP will always transmit anyway

Q: would prefer to see a simulation for carrier sensing included

A: if one AP is transmitting, the other AP will not be able to transmit on its own

Q: slide 5, do you assume that AP2 starts after receiving the ASR frame?

A: yes

Q: if there are 3 or 4 AP s, then what

A: scheme shown is only for 2 AP

Q: in the multi AP configurations, what happens?

A: any AP winning contention always only chooses one of the other AP

Q: what happens in the presence of UL?

A: might not have the invited AP share CSR, but the link is already busy anyway, so that is effectively an existing case of SR

Q: limited to 2 AP because too many paths to analyse, otherwise

A: yes

Q: announcement phase, AP1 tries to do CSR with AP2, what happens if AP2 already has something else going on?

A: could have an ACK to ASR, but even without an ACK, AP1 will go forward

Q: slide 5, learning phase, any special sounding? AP TX PWR levels need to be known.

A: might consider a sounding protocol, or use beacons, and collect responses, might consider routine beacon receptions for determining paths

Q: what is meant by complete control

A: could have total coordination which uses a master AP which collects all path information and then makes CSR decisions and dictates which can perform transmissions at any time, just for comparison, not focusing on that scheme

Q: slide 7, assume that initial winner does not use a reduced MCS to encourage SR possibility?

A: correct, AP will maximize local throughput, no compromise for the winner, but invite some other transaction if it still fits in the SINR

Q: without sharing, suppose the master is MCS5, and you maintain 10%, is that at MCS5?

A: stay at MCS5, if, for example, an AP is operating at MCS11 with a target STA, and the AP cannot identify any neighbour AP that can CSR without allowing the MCS11 to continue, then you do not invite any AP to share CSR

Q: if you have some MCS and TX PWR for 10%, you can drop power, then with perfect feedback, you need to leave some margin to support MCS5, in such a case, how much margin to you really have

A: simulation is perfect, so we could introduce some more realism as a follow up

No straw poll

1. [**0052r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0052-00-00be-multi-ap-sounding-discussion.pptx)**, “Multi-AP Sounding Discussion” – Yonggang Fang (ZTE)**

**Summary:** The authors present a proposal for using coded sounding symbols to reduce the overhead of the multi-AP joint sounding function.

**Discussion:**

Q: is the two inflection method actually a code based method?

A: depends on how you form the p matrix

Q: tone selection is better than a general coded method, with fading, different powers on different tones, dispreading at receiver, you will not get as good a result, will see a difference in high Doppler scenario

Q: slide 4, after trigger frame, coordinated AP sends a joint NDP at the same time?

A: if it is a coordinated AP, then it is joint sounding, so there will be a joint NDP

Q: but the time of departure of the frames will be different from the two Aps

A: yes

Q: the STA could have different distances to the Aps, so the arrival times will be different, in the freq domain, you will see a linear shift, this will hurt the orthogonality

A: depends on how large the timing error is, in our simulation, we did not include this

Q: compare overhead reduction vs the sequential method?

A: sequential sounding has higher overhead because of the multiple NDP, the total time of the sequence is much longer, for code based, does not introduce more overhead, similar to tone based joint sounding in terms of overhead

Q: perfect time synch is not realistic, this method was compared with tone interleaver method and orthogonality is not maintained with timing errors for this method, check that other contribution, from Samir

A: ok

Q: agree with previous commenters, need to see performance in the presence of some synchronization errors

Q: these codes are similar to BSS color, i.e. need to be different per AP, need to know the mask before receiving the sounding frames

A: code space is probably larger than BSS color space to achieve good performance

Q: need different set of sequences for differnt numbers of APs involved and a method to indicate what code is in use by each AP

A: agree

Q: echo comments on timing synchronization

Q: slide 5, what is the Ng assumption?

A: depends on how many APs are involved in the joint sounding

Q: what method is there for CFO adjustment among the AP s

A: if there is a difference in freq, then there will be degradation, but it is not much

Q: joint sounding LTF and single AP UL MU MIMO LTF will be the same or different?

A: did not study

Q: would object to having more than one type of LTF, prefer a solution with a single LTF for all purposes

A: understood

No straw poll

1. [**0123r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0123-00-00be-channel-sounding-for-multi-ap-cbf.pptx)**, “Channel Sounding for Multi-AP CBF” – Feng Jiang (Intel)**

**Summary:** The authors present a discussion of design considerations for channel sounding in multi-AP CBF using sequential channel sounding and explicit CSI FB, CSI from OBSS STA and modelled on 11ax sounding protocol.

**Discussion:**

Q: NDP1 and NDP2 are to be received by other BSS STA s, right?

A: yes

Q: need addressing to tell them to receive these sounding frames and for STA s to communicate to other APs

A: yes, detail not yet addressed

Q: how does AP2 know when to send NDPA2?

A: single TXOP requires some new method, maybe AP2 monitors BFRP trigger and reports

Q: maybe AP1 can send a frame to AP2 to share the TXOP

A: yes

Q: if not same TXOP, channel might drift between NDP1 and NDP2

A: agreed, cannot wait too long

Q: slide 9, NDPA1, NDPA2, similar information, why not combine and then master AP sends NDPA once, and no slave AP NDPA

A: if only master, then some STA in AP2 BSS might not hear that NDPA, NDPA from AP2 could be different as well

Q: STA needs a larger buffer as well, if he is not allowed to send FB before the next NDP reception

A: yes

Q: slide 9, two green arrows going up, CSI report is that including for NDP2?

A: no, first CSI report is only for NDP1, second CSI report for NDP2

Q: reason for the separation is that some STA from other BSS cannot hear, then how can those STA hear the BFRP trigger?

A: maybe before this multi-AP CBF sounding, master and slave exchange information on which STA s can be included in the CBF TX, so that only those STA will perform the sounding exchange

Q: if that is true, then if buffer space is not a problem, then only one NDPA is needed

A: still want separate NDPA1 and NDPA2 because they might include different sets of STA, some used for CBF and some not

No straw poll

1. [**0071r0**](https://mentor.ieee.org/802.11/dcn/20/11-20-0071-00-00be-joint-transmission-for-11be.pptx)**, “Joint Transmission for 11be” – Ron Porat (Broadcom)**

**Summary:** The authors present a contribution which contains a list of contributions that suggest that there is a general agreement that there are gains and that simulations have been performed and joint sounding NDP was already agreed, with a straw poll proposing that Joint transmission for single and multi user for the multi-AP topic be added to the SFD.

**Discussion:**

Q: is it possible for a non-AP STA to receive a jointly transmitted PPDU as if it is from a single AP without modifying the receiver requirements?

A: we believe it is possible to receive without making any receiver changes, assuming no particular per-AP adjustments, treat the PPDU as a normal reception, if the packets are too long, the relative error in the clocks at the AP s will eventually create a large enough error to reduce the performance

Q: do we need a new receive procedure, or a new one?

A: no new procedure for the recipient side, only for the transmitters

Q: difficult to decide, fundamental problem is the backhaul communication for passing data between joint transmitters, if the backhaul is wireless, then this might be a problem, especially if backhaul and fronthaul are sharing a channel, suggest a straw poll with an assumption about wired backhaul, modify the straw poll if the backhaul is wireless

A: we could modify the straw poll, ask you to examine 11-19-1909 which explores the wireless backhaul case, you can look there and see gains in that case, JT comes out ahead and does not fail – we do not want to exclude the wireless backhaul case, for a home mesh scenario

Q: generally in favour, assume that this is accepted as R2, what is the plan, for sounding procedure definition, set up procedure, should this be an independent design, or shared for other joint mechanisms? COFDMA, CSR, CJT, for R2, other mechanisms not commonly used, what is the plan for R1 vs R2

A: much of the procedures could be shared

Q: agree that some might be re-usable, some maybe not, needs further discussion

A: ok

Q: for JT, do you assume that the total number of streams is limited to 16?

A: yes, others have shown that 1 AP w 16 vs mAP w 16 total gives similar results, allows to share the single sounding procedure, for example with the multi case

Q: will you continue discussion or move forward with this SP?

A: will continue to discuss Release 1 topics first, we could still submit ppt for this item – possible to make the procedures similar to the single-AP case in R1 and then it is almost there

Q: support the position presented, note that previous presenters discussed CSR and CBF, 11be will eventually support these various coordinated mechanisms, one at a time, or all of them, in your view?

A: all will eventually exist in the specification and each implementer will have to make a decision as to which ones to support, varying complexity

Q: similar to previous question, in your opinion, there will be overlap between the procedures defined?

A: that is desired, yet, COFDMA has specific FB requirements, joint requires sounding differences, coordination process could be common, but FB information is likely to be different, AP requirements are tighter for some mechanisms, the framework seems similar

No straw poll

1. [**11-19-1923r0**](https://mentor.ieee.org/802.11/dcn/19/11-19-1923-01-00be-revisiting-harq-complexity.pptx)**, “Revisiting HARQ Complexity” – Shimi Shilo (Huawei)**

**Summary:** The authors present a contribution which reviews various contributions on HARQ and provides a position that is a response to the summary of those contributions, including making modifications to earlier presentations from the author(s) on the HARQ topic.

**Discussion:**

Q: agree that HARQ is possible, memory is the biggest problem, no change in transmitter side, you assume chase combining case, what about IR?

A: minor design changes, on slide 3, think that if it can be done without encoder changes, do not change LDPC matrix, that is preferable, TX side changes can be minimal

Q: another solution, OFDMA, for example

A: we have discussed it, the main reason is that the scheduler has information about specific RU, but it has no idea about other RUs, could consider more sophisticated FB, how much can you trust the information, does the scheduler use optimized MCS? Most implementations actually use some type of rate adaptation which optimizes over time and do not want to create an immediate MCS estimate

Q: there could be other solutions

A: I agree

Q: memor shrink, 4.5, how did you get that? Totally linear would be 16

A: we had 10 previously, we had not talked to design guys, now, 28 v 7 nm is a different process, so it is not exactly 16:1, but it is not that significant, so we settled on something more like 4.5:1, based on TSMC

Q: number of iterations, is it less because you have better LLRs after combining?

A: yes, that is the expectation and slide 12 shows simulation results which confirm this

Q: slide 9, memory estimate, only for one single PPDU?

A: no, based on PER and CW Error Rate, number of bits, memory requirement is based on number of failing CW, not a complete PPDU

Q: these numbers are for a single link?

A: is it good for UL? I don’t know. Every row in slide 9 is for a different BW and MCS, the throughput per STA is not that high, long term, an AP UL would have to store data for many STA over time, yes, the memory requirement will increase

Q: some linear relationship for number of supported STAs

A: yes, but these are high throughputs and if you had multiple STAs UL, that would be an extreme scenario

No straw poll

**Call by the chair for AoB:** No other business noted.

**Adjourned at 19:03.**