IEEE P802.15
Wireless Specialty Networks

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| IEEE 802.15.13 September, 2018 Interim Meeting Minutes for Kona, Hawaii |
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Abstract

# This document contains the TG13 Multi-Gigabit/s Optical Wireless Communications Meeting minutes from the September Interim meeting in Kona, Hawaii.

**IEEE 802.15.13**

**Monday, September 10, 2018, PM1**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

John Li Qiang (HiSilicon)

Tuncer Baykas (Mediopol Uiversity)

Richard Roberts (Intel)

Nikola Serafimovski (pureLiFi)

Tushar Sharin (Apple)

Matt Chang (Apple)

Xu Wang (VLNComm)

1. The Chair presented the agenda doc. 15-18/0418r0 and read the relevant attendance and IP elements. The agenda was amended to include the approval of minutes from the July 2018 Plenary session as well as the minutes from the teleconferences.
2. The agenda (doc. 15-18/0418r1) was approved with unanimous consent.
3. Meeting minutes for July 2018 plenary (doc. 15-18/0419r0) were approved with unanimous consent.
4. Meeting minutes for the three teleconferences between the July 2018 plenary and the Sept. 2018 interim (doc. 15-18/0420r0, doc. 15-18/0421r0, doc. 15-18/0422r0, doc. 15-18/0423r0) were approved with unanimous consent.
5. There has been a general discussion on polling compared the reservation (current) scheme.
	* In polling, the specification (resource reservation) can be updated at each polling event which is much quicker, more dynamically compared to super-frame specification. The advantage depends on the how dynamic the resource reservation update is required. However, polling can introduce overhead and unpredictable delay (latency variation, i.e. jitter of packet arrival time).
	* The reservation-based scheme has less overhead, works better together with distributed optical frontends, and allows a coordinated channel access in time and space which is required to meet industrial requirements highlighted in the TG13 PAR.
	* The question is whether to choose one over the other or both.
	* The current specification basically specifies half duplex.
	* Can the coordinator make a reservation in current CAP? The reservation is updated based on ACK. Polling is only in CAP based on some understanding in the group.
	* Xu explained VLNComm implementation on MAC. The drawback of polling CAP is that collision is guaranteed in the wildcard slot when there is more than one new device.
	* **The group agreed that each party should prepare and present one or two slides explaining the MAC implementation that is also uploaded onto Mentor.**
6. Moreover, there has been an intense discussion on CCA and RTS/CTS because some members of TG13 believe it is impossible for OWC. The discussion about this claim has already been started during teleconferences.
* In principle CCA makes sure the device that receives something is not transmitting, e.g., transmitting device uses CCA to make sure coordinator is not transmitting before transmitting.
* CCA will not work among OWC devices that cannot see each other. Only in the downlink, all devices should see the coordinator and CCA could work, but not in the uplink where only the coordinator could see the collision of packets from devices that start to transmit simultaneously.
* It has been argues that there is no guarantee that CCA alone leads to a reliable result but when it is used it reduces the probability of collisions. For ensuring that collisions are avoided also in the uplink, device and coordinator need to use the RTS/CTS mechanism in addition.
* What about removing CCA, and simply keeping the RTS/CTS scheme which is known to solve the hidden terminal problem.
* CCA should be long enough to include at least one uplink and one downlink transmission.
* 802.11 implementation of CCA has been discussed.
* It has been proposed to keep CCA and RTS/CTS optional. We can see that, if there is a certain topology, random access mechanism is needed by any party to decide if we want to keep in the draft. The group agreed on the suggestion.
1. The discussion was continued around the ability to use various transmissions in CAP and/or CFP.
* CSMA/CA and Polling are part of the CAP and do not conflict with the CFP of the superframe structure in D3.
* The use of CAP could be basically to prepare deterministic access where certain small sections of the superframe are left open for contention-based access.
* It is has been requested again that different MAC proposers should provide at least 1-2 slides to describe their different ideas of using a superframe or not.
1. Discussion came back on the use/applicability of the CCA and therefore the applicability of the current CAP MAC proposal. The debate is whether the CCA is applicable only between the station and the coordinator or between all nodes.
* CCA could be used to only to avoid transmission while the coordinator is broadcasting, while RTS/CTS is used to deliver channel access for the remaining time.
1. It was suggested to bring a list what features in the MAC are needed in 802.15.13 and what are not.
* The current specification which has been taken over basically from 802.15.7 which is a legacy of an incomplete version on 802.15.4-2011 and still contains errors and is full of features that are actually not needed for 802.15.13. So they could be removed to reduce complexity and avoid unnecessary errors.
* It was suggested not to take into account features just because they have been in the standard previously but nobody knows if they would bring any benefit in the context of 802.15.13. In that case they should rather be deleted.

The meeting is in recess.

**Tuesday, September 11, 2018, AM1**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

 John Li Qiang (HiSilicon)

Tuncer Baykas (Mediopol)

Nikola Serafimovski (pureLiFi)

Harry Bims (Bims Laboratories)

Xu Wang (VLNComm)

1. The Chair updated the agenda. The updated agenda was agreed in doc. 15-18/0418r1
2. Xu Wang (VLNCcomm) presented doc. 15-18/0451r0 which describes the proposed frame structure.
* The number of users associated with the coordinator (“Sync Slot M”) is flexible and can be scaled up to 7 or 15 users.
* The SYNC Slots are then held fixed for the total number of users that can connect to the coordinator.
* However, the CFP is divided with respect to the number of active users that are associated with the Coordinator.
* Currently, the CFP is full-duplex while the CAP is half-duplex
* The HCM codes are orthogonal and therefore each HCM row is treated as a separate frame.
* The length of each TDM slot does not need to be the same.
* The SYNC slot that is successfully associated with the coordinator keeps the same SYNC slots for the next transmission. Over these slots, control traffic can be exchanged between the device and the coordinator. There is a maximum number of users that can be associated and any other device that looks for association is rejected.
* Discussion around how the slot allocation is completed during the CAP. Multiple users can attempt to associate at the same time slot in the CAP and there is a certain probability of collision if two devices are asking to be associated for the same SYNC Slot. However, this probability is very small if few users are connected only.
1. Chong Han (pureLiFi) presented doc. 15-18/0450r0 which contains the proposed frame structure.
* Polling mechanism fits into the entire superframe structure
* There is a list of topics comparing the previous random access mechanism with polling.
* It was explained that polling can work without having a superframe structure at all. One proposal is that polling is only used in CAP and GTS is used in CFP.
* Q: If the second beacon (B) frame is removed from page 3, the proposal falls in the same as the existing superframe structure.
* A: First B is beacon for the duration of the superframe, the second B is for the duration of the random access period.
* In the polling, the coordinator polls single devices one by one in the “wildcard” slot representing the random access period. The device initiates the transmission without being polled. But if two devices want to access the channel, there is always a collision.
* It was suggested that the difference between the proposed random access period and the current CAP scheme is that coordinator responds to the uplink random access in the form of a broadcast, and there are a few rounds of uplink random access during the random access period, but in the draft, each uplink random access is responded individually.
* Q: What is the reason of having more than one beacon frame.
* A: The polling adds flexibility to the duration of random access period and polling period.
* C: The beacon in the sense of the polling, is more of a control frame.
* A: Agreed.
* C: Suggest to rename “B” into “C” as it is actually a control message which indicates the beginning and end of the polling period.
* **The team proposed to use polling mechanism as a solution for the non-beacon enabled mode and the deterministic access in the beacon-enabled mode.**
* This was considered an interesting idea in general and will need to be considered further after hearing all presentations.
1. Kai Lennert Bober (Fraunhofer HHI) presented doc. 15-18/0410r0 which considers a scenario with multiple OWC frontends connected to a centralized coordinator.
* In industrial applications, in order to overcome blockage of the LOS, it is useful that multiple OWC frontends transmit the same signal to a device in the downlink. Likewise, the signal from one devices should be received by multiple frontends in the uplink.
* These delays can be in the order of 100s of microseconds.
* In order to facilitate such joint transmission and detection, assuming OFDM, there should be no inter-symbol-interference, i.e. the delay between the coordinator and the multiple optical front-end needs to be roughly the same (variation is less than ½ of the cyclic prefix, no more than 800 nanoseconds).
* This can be reached by using analog fronthaul connections between the CO and the DEV or Ethernet with precision time protocol (PTP) IEEE Std. 1588v2.
* When transmission bandwidth is wide, there can be fading holes in the compound channel between two or more frontends and a device, due to unequal propagation delays.
* The objective here is to propose a mechanism that compensates for these residual delays so that the signals arrive time-aligned at the device.
* The MAC is therefore expected to synchronize the data delivery at the PHY for the different frontends serving the same device and compensate for the “cabling delay”.

Meeting is in recess.

**Tuesday, September 11, 2018, AM2**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

John Li Qiang (HiSilicon)

Tuncer Baykas (Mediopol)

Nikola Serafimovski (pureLiFi)

Xu Wang (VLNComm)

1. The Chair reviewed the agenda and the agenda was updated in doc. 15-18/0418r1.
2. Kai Lennert Bober (Fraunhofer HHI) continued the presentation with doc. 15-18/0411r0.
* There was a discussion about the use of MIMO pilots and their relevance to the association and reconnection of a device.
* The key element is the ability to coordinate the communications of multiple optical frontends (OFEs) that support the same information from one device.
* The advantage of such “soft-handover” or “macro-diversity” scheme over classical handover is that the typically strong interference at the cell edge, where signal of serving and interfering cells are similar what leads to bad SINR, is circumvented. In the proposed scheme, both cells would send the same signal and there is kind of constructive superposition of the two signals rather than strong interference among them.
* That approach could enable a more consistent performance at the cell edge. The user would not expect strong performance variation on a scale of few meters when moving between two optical frontends. With the suggested scheme, the performance variation is proportional to the illumination level, what is felt more intuitive for the user.
* The fundamental need therefore is that the (re)association frame request includes a CSI feedback message from the device about different OFEs. The (re)association frame is broadcasted from the device to the network of OFEs during the CAP and therefore CSI will be feedback to the centralized coordinator in each superframe.
* This enables the coordinator to use a distributed MIMO scheme where only those OFEs that are seen by a single device form a so-called “virtual cell” and transmit information jointly to that device. As said, thereby the scheme also removes interference, while devices that see different OFEs from the coordinator can be supplied simultaneously with their data.
* That way, this also approach enables SDMA in the sense that virtual cells which are not overlapping can transmit data to their users simultaneously, hence the optical modulation spectrum can be reused in the spatial domain. In case virtual cells do overlap, the transmission will be scheduled orthogonal e.g. in the time domain when using TDMA.
* The feedback control frame could also be transmitted during the GTS for the CFP.
1. Chong Han presented doc. 15-18/0396r0 pointing to the new items.
* Type 1: payload CRC error (cannot decode data) in the case of high-reliability header, still shows the polling information
* Type 2: header CRC error (cannot decode header)
* Type 3: packet is under detection threshold,
1. There was a general discussion how to move forward.
* The standards aims to have only one MAC in which even multiple PHYs are allowed. There was a proposal to use the same beacon field in the beacon frame in beacon-enabled network, and polling frame in the non-beacon network.
* There may be no need to use beacon frame for advertising non-beacon network.
* If a device sees a poll frame, it will know:
1. this is a non-beacon enabled network,
2. this is random access or polling phase.
* If a device receives a beacon frame, it will know it is a beacon-enabled network.
* The name of the frames doesn’t forbid unifying a certain field to be shared between the beacon frame and poll frame.
* There should be a discussion of unifying MAC frame offline and resolved the issues.
* **After that discussion, the committee agreed to move the proposed polling schemes exclusively into the Non-Beacon Enabled Mode, while the remaining MAC proposals are to be consolidated together to work in the Beacon Enabled Mode.**
1. **MOTION: 802.15.13 MAC will support beacon-enabled and non-beacon enabled modes. In the beacon-enabled mode, there will be random access in the CAP and deterministic access in the CFP. In the non-beacon enabled mode a polling scheme will be used. There will be no polling in the beacon-enabled mode.**

**Moved: Nikola Serafimovski**

**Seconded: Li Qiang (John)**

**Yes/No/Abstain 4/0/0**

Meeting is recessed.

**Tuesday, September 11, 2018, PM1**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

John Li Qiang (HiSilicon)

Tuncer Baykas (Mediopol)

Nikola Serafimovski (pureLiFi)

Xu Wang (VLNComm)

1. Kai Lennert Bober (HHI) continued the presentation of doc. 15-18/0411r0.
* There was a discussion about the channel estimation and feedback of the CSI. The suggested scheme was taken over from previous RF work and may be simplified.
* Using adaptive quantization ensures that the quantization noise is the same as the thermal noise. At this point, the minimal number of bits is needed and corresponding overhead is minimized.
* Key information is to understand what OFEs can be seen by the device and to know the delay seen for each OFE by the device.
	+ Two distinct aspects:
		- Identify the strongest OFE
		- Feedback the delay
* Q: Is there the possibility to send the CSI for the amplitude of the different OFEs same as the information to be used for different MCS levels.
* A: No, since this is confusing. The amplitude information from all OFEs seen by a device is used to select the strongest OFEs that will transmit jointly to the device in a virtual cell. After the OFEs have been selected, they transmit jointly and create a resulting effective SNR. This resulting effective SNR is measured separately to determine the MCS. Selecting the OFEs in a virtual cell and determining the MCS are two independent control loops, as the selection can be done at the device side while the resulting SNR also depends on the receiver algorithm in the device. Feedback of MCS is done in the same way as in a single-OFE-to-single-device link.
* Discussion on the location where multiple variable, optional information elements should be defined and included.
* Discussion on the possibility to rearrange the current draft text to have a more compact writing style where all information regarding a particular feature can be located in the same section.
* Discussion on the need to introduce various information elements as potentially optional elements within the General MAC frame format.

Meeting is in recess.

**Wednesday, September 12, 2018, PM1**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

John Li Qiang (HiSilicon)

Tuncer Baykas (Mediopol)

Nikola Serafimovski (pureLiFi)

Chong Han (pureLiFi, remote)

Harry Bims (Bims Laboratories)

Xu Wang (VLNComm)

1. The Chair presented the agenda and the updated agenda was agreed in doc. 15-18/0418r2.
2. The group discussed the need for a new Technical Editor
* John Li Qiang (Huawei) cannot attend the meetings regularly anymore. Chong Han (pureLiFi) volunteered for this position and was elected with unanimous consent as the new Technical Editor to continue the work on the draft.
1. The team discussed the possibility of an ad-hoc meeting before the next IEEE plenary on Nov. 11th to 16th in Bangkok. The objective would be to make more progress with the MAC and have John involved in this discussion who cannot travel to Bangkok. The decision was postponed after the comment resolution.
2. The team postponed all other items and moved on to the comment resolution aiming at finishing it during this interim meeting.
* For the comments being resolved, John will mark in the draft with mark tracing and convert the draft in MS Word format and hand it then over to Chong. The work of Chong will then be continued in MS Word. John will help to bring back the final text into Adobe frame maker after a stable draft has been reached.
* Next, the team continues to resolve the comments as normal pace. The later updated draft shows exact texts that are agreed to be kept.
* It is suggested by the new Technical Editor to copy the relevant old text from MS Word, modify it, upload the new text in a contribution and make a comment to include the new text into the next draft. This is considered more efficient than the previous procedure. It was agreed to proceed in this manner and see if it proves practical or not.
* Comment resolution stopped at comment 49.
* Since the Technical Editor (John) needs to leave the meeting, comment resolution will resume in Thursday AM2 meeting.
* It is agreed to postpone comments 49, 50, 51 until John is available next time.

Meeting is in recess.

**Thursday, September 13, 2018, AM2**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

Tuncer Baykas (Mediopol)

Nikola Serafimovski (pureLiFi)

Xu Wang (VLNComm)

1. The Chair presented the agenda and the updated agenda was agreed in doc. 15-18/0418r2.
2. The comment resolution is continued.
* The resolution of all comments is being recorded in doc 15-18-0437r2.
* Comment resolution is not complete due to limited time during the meeting.
* The team agreed to keep the resolved comments and reject the remaining unresolved comments in doc 15-18-437r2.
* The team agreed to give the technical editor the right to integrate the resolved comments into draft 4. After the draft 4 is made available to the task group, all remaining comments to draft 3 that have not been resolved can be resubmitted against draft 4.

**Thursday, September 13, 2018, PM1**

Attendance

Volker Jungnickel (HHI)

Kai Lennert Bober (HHI)

Tuncer Baykas (Mediopol)

Nikola Serafimovski (pureLiFi)

Xu Wang (VLNComm)

1. Chair presented the agenda and the updated agenda was agreed in doc. 15-18/0418r2.
2. The unresolved comments (mostly due to there is not enough time left) are rejected and will be open to resubmit against the upcoming draft 4.
3. The editorial comments are resolved by accepting all except two that are without proposed resolution, but more actions are required for some comments.
4. Motion:

**TG13 approves the technical comments resolved in doc. 15-18-0437/r2 and is going to update TG13 draft accordingly. The Technical Editor is granted the right to work in all accepted editorials comments.**

**Motion passed 3/0/0.**

1. Doc 15-18-0267-r5 is reviewed
* The Chair suggests to review the document and discuss it again in the next telco. It was suggested to bring comments against the text in the next telco.
1. The TG agrees to have telcos on
* Oct. 4th (9:30AM to 10:30AM EDT) to address LB-PHY and HB-PHY.
* Oct. 16th (10:30AM to 11:30AM EDT) to start the MAC layer converging. Xu will introduce the proposed text on MAC layer.
* Oct. 23rd and Nov. 6th (8:00AM-10:00AM EDT) to have more discussion on MAC.
* The Chair will send out WebEx invitation via the email reflector.
1. It was decided that there previously discussed Ad hoc meeting in Beijing is not needed. The discussion for updated and obsolete MAC functionality is postponed to the telcos.
2. The plan for November meeting has been discussed. It includes:

- comment resolution against D4

- motions to include new text into D5

- other preparations for D5

- possible motions to start WGLB.

1. The timeline in doc. 15-18-0288r7 has been reviewed and updated.
2. A Motion to accept the updated timeline is passed with unanimous consent.

The meeting adjourns.