IEEE P802.15
Wireless Specialty Networks

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Abstract

# This document contains the TG13 Multi-Gigabit/s Optical Wireless Communications Meeting minutes from the IEEE 802.11 Warsaw meeting, May 2018.

**IEEE 802.15.13**

**Monday, May 7, 2018, AM2 Session**

Attendance: around 20 people

1. The IEEE 802.15.13 TG meeting was called to order by the Chair, Volker Jungnickel (HHI).
2. Chair introduced the patent policy and logistics of the group
3. Approval of meeting minutes of March in 18-0158/00

Minutes were approved by unanimous consent.

1. Self-introduction of attendees.
2. Chair went through the agenda of the week

The agenda was approved by unanimous consent.

1. Sang-Kyu Lim (ETRI) presented 18-0166r2 “Evaluation results on preamble of PM-PHY”

Q:: on slide 21, detection in AWGN seems worse than some cases with larger delay spread.

A: AWGN shows similar performance with other evaluation assumptions, but not worse.

Q: How down sampling was performed.

A: 1 GHz ADC is used for sampling. For each bit symbol, multiple samples are obtained and averaged to get one bit symbol.

Q: Which PHY was assumed for simulation.

A: Pulsed Modulation-PHY. Chair also introduced three PHY types in the draft and different use cases.

1. Sang-Kyu Lim (ETRI) presented 18-0169r2 “Evaluation Results on header of pm phy”

Q: Why theoretical performance is worse than the case with RS encoding?

A: Theoretical performance means the performance with 2-PAM in AWGN channel. Therefore, it can be worse than the cases when transmitted data are encoded.

Q: How un-coded transmission shows better performance than when encoded?

A: No clear explanation yet, need to double check the evaluation assumptions.

Q: How channel modeling is performed.

A: It is based on the ray tracing.

1. Sang-Kyu Lim (ETRI) presented 18-0171r2 “Evaluation Results on Payload of PM PHY”

Sang-Kyu mentioned the RS code rate used is RS(255, 239) instead of RS(256, 248) because his simulation toolbox does not support it and RS(255, 239) is used in a couple of other standards.

C: If RS(256,248) has certain issues, it may not the adopted in the standard.

Q: Is there is any proposals to the draft.

A: Not yet. The text proposal for PM-PHY currently contains two preamble designs and still further consensus is needed.

1. Volker Jungnickel (Fraunhofer HHI) presented 18-0170r2 “PM PHY Synch Evaluation”

Q: Why threshold is set according to 0.1% false alarm rate?

A: It is agreed in the evaluation framework that preamble need to achieve 0.1% false alarm rate and header need to achieve 1% error rate. Furthermore, payload need to achieve 10% error rate.

1. The meeting recessed until PM1.

**Monday, May 7, 2018, PM1 Session**

Attendance: around 15 people

1. The IEEE 802.15.13 TG meeting was called to order by the Chair, Volker Jungnickel (Fraunhofer HHI).
2. Chair introduced the patent policy and logistics of the group.
3. Volker Jungnickel (Fraunhofer HHI) presented 18-0173r0 “PM PHY Header and Payload Evaluation”

He pointed out that also in these simulation results, 8B10B scheme does not show any coding gain which is not immediately reasonable.

Q: Maybe SNR calculations are not be correct.

A: Should not be the case but to be checked.

C: BER curve with channel encoding should cross over the BER curve without channel coding, but the results does not appear so.

A: Volker will check this with existing results.

Q: If evaluation results show some unexplained phenomenon they cannot be used for decisions.

A: The benefits of 8B10B is dealing with baseline wander.

Q: Issues with current channel model: Only propagation is modelled while transfer function of LED including bias-T in the driver and photo detector with high-pass behavior to suppress fluorescent light are not yet modelled. These transfer functions will show the effects of baseline wandering. PM PHY is already designed so that these effects are minimized through either 8B10B or HCM. But since these impairments are not yet reflected in the channel model, their effects are not visible in the results.

C: Channel model should be extended to take into account of the characteristics of LED and photo detectors.

1. Volker Jungnickel (Fraunhofer HHI) presented 18-0190/r0 “On PM PHY parametrization”

Q: Whether the proposal uses a long preamble sequence with 394 symbol

A: That assumption is for discussion. The results show that if HCM is used, a long sequence is needed for the preamble. The length of the preamble may be adaptive and decided by higher layers.

C: If preamble sequences with different length are introduced, it may be beneficial to use unified structure. For example long sequences may be built from the same short base sequence. It could reduce the efforts on blind detection on the receiver side.

1. Daniel Chew (JHUAPL) presented 18-0187/r1 “Partial Evaluation of PM-PHY using TG7r1 Channels”.

Q: Do you need an ADC to include pulse shaping?

A: No, there are analog methods of adding the pulse shaping that are cost effective.

Q: How would an root-raised-cosine (RRC) PAM compare to an OFDM PHY.

A: This depends on the beta factor of the (roll off factor), if the same roll-off factor then it should be the same. OFDM is comparable to RRC with zero roll-off. It would have a much larger PAPR compared to PAM but then you have to bring in a DAC. OFDM BER performance is going to be worse, because PAM will allow more energy per bit.

Q: Are you doing time domain equalization and if so why?

A: Did not see the benefit to go from time domain from the PAM to the frequency domain. In OFMD, you get the frequency domain for free. The equalizer worked very well in the time analysis.

Q: How does the RRC compare to using Gaussian filter?

A: Gaussian Filter has a problem with inflicting ISI which causes issues. To do this a Viterbi coder would need to be implemented to track state.

1. The meeting recessed until Tuesday.

**Tuesday, May 7, 2018, AM1 Session**

Attendance: 12 people. Pat Kinney and Benjamin Rolfe from 802.15 WG were invited for a discussion on MAC.

1. The IEEE 802.15.13 TG meeting was called to order by the Chair, Volker Jungnickel (HHI).
2. Chair reminded attendees to check attendance.
3. Chair introduced the current situation of MAC developments in TG13.

Pat commented that in 802.15 there are two different types of MAC, i.e. 15.4 MAC and 15.3 MAC. 15.4 MAC is intended for simple devices and low cost; 15.3 MAC was designed for high throughput. Suggested to clarify the need of the task group.

1. Chong Han (pureLiFI) presented doc. “18-167/r0 Proposal of polling mechanism in both CFP and CAP”

Q: How sensing is made in CAP.

A: No sensing, just backoff; scattered light can be used for sensing; RTS/CTS is introduced to avoid collision.

Q: What is the purpose of CAP and CFP?

A: CAP is mainly used for association and maintenance, and data transmission without a constant connection. CFP is used for when there is a constant connection.

Q: What about hidden nodes problem. Light propagation is supposed to be strongly directional. How to solve the hidden node problem?

A: RTS/CTS was introduced to alleviate the issue.

Q: Does the standard support peer to peer and star topologies?

A: Both are supported. However these two topologies do not exist at the same time.

 Q: What is the expected energy requirements?

A: Diverse requirements, light on the ceiling does not care energy consumptions while mobile device is more sensitive.

Q: Why CAP is also used for data transmission since GTS and CFP is already introduced.

A: GTS is obtained when asked, it is needed when there is a constant need for connection.

Q: Discussions on whether both full duplex and half duplex are supported

A: Any PHY exclusively for full duplex? No.

C: For full duplex, it was recommended to study the Ethernet MAC protocol.

C: It is suggested that for CFP, some GTS could be shared by multiple devices. Thus polling could be used.

1. Kai Lennert Bober (Fraunhofer HHI) presented doc. “18-202/r1 TG13 MAC considerations for distributed MIMO”.

Q: Does fronthaul has an address?

A: No, it is just an analog or digital link the latency of which has to be considered in the MAC protocol.

Q: Why it was suggested “Superframe spec” to be transmitted in ad hoc way rather than in beacon?

A: There are potentially a large number of devices in the same VPAN. These are two alternatives, superframe specification with TDMA and Polling. Transmission with lower latency is possible with polling. It can be considered as transmitting the superframe specification in pieces per each device. In both ways, spatial reuse can increase the throughput.

Q: How long channel can be stable so that the channel measurement feedback can be useful?

A: Assumption is around 10 ms. It was explained that when moving at 1 m/s a Rx with diameter of 1 cm will be blocked in only 10 ms.

Q: What do you consider as low latency? It was explained that there are statements from industry that 95% of use cases in industry can be served when latency is less than 5 ms. Some special applications may require even sub-millisecond latencies.

1. Meeting recessed.

**Tuesday, 08 May 2018 – AM2**

Attendance:

* Volker Jungnickel (HHI) – Chair
* Kai Lennert (HHI)
* Sang-Kyu (ETRI)
* John Li (Huawei)
* Tuncer Baykas (Mediopol University)
* Nikola Serafimovski (pureLiFi)
* Chong Han (pureLiFi)
* Masood Maqbool (Apple)
* Chris Hartman (Apple)
* Brima Ibrahim (NXP)
1. Chair called the meeting to order.
2. John Li (Huawei) presented doc. 15-18/0185r0. There was discussion about the purpose of the “Frame pending” control field in Slide 4.

Q: What is the need to provide the destination of the address for the station to be provided in two locations.

A: The source for having 2 fields was the relay feature using Decode & Forward. If there is a decode & forward, then does it make sense to also identify the source of the packet? Tuncer has agreed to provide a contribution about the relaying concept to check this information and introduce the relevant parts.

Q: What is the need for security to be introduced in the current text

A: The security could either be made optional or removed

Q: There was a question about the Integrity Check Value introduced in Annex H which was clarified by Chong.

1. Chong Han (pureLiFi) presented doc. 15-18/0228r1 to explain the meaning and value.

C: Chong to provide the brief explanation text for the ICV in the revised MAC proposal.

1. The group agreed to adopt the general MAC frame format.
2. The group agreed to adopt the proposed structure for the Frame control.
3. Chong (pureLiFi) and Kai (HHI) proposed to remove the Frame Pending field on slide 4.
4. The group decided to take Option 2 (two octets) on slide 5.
5. The group decided to agree on the general structure on slide 6, provided that more information will be made available at the next 802.15.13 meeting in July 2018.The group did not reach a decision on this point.
6. There was a discussion about the length and structure of the Address Field and understanding the required/optional elements.
7. The group agreed to adopt the security protocols from 802.15.4-2015 as an optional feature.
8. There was a discussion about the use of the security fields and what security suits could be implemented.
9. The meeting is in recess until Tuesday, PM1.

**Tuesday, 08 May 2018 – PM1**

Attendance:

* Volker Jungnickel (HHI) – Chair
* Kai Lennert (HHI)
* Sang-Kyu (ETRI)
* John Li (Huawei)
* Tuncer Baykas (Mediopol University)
* Nikola Serafimovski (pureLiFi)
* Chong Han (pureLiFi)
* Masood Maqbool (Apple)
* Chris Hartman (Apple)
* Brima Ibrahim (NXP)
1. The Chair called the meeting to order.
2. John Li (Huawei) presented doc. 15-18/0185r0.
3. The group decided to use the 32-bit CRC generator proposed in Annex H.
4. John will upload the revised version of 15-18/0185r1.

**MOTION:**

**The TG13 MAC will be based on the decisions on Slide 11 in doc.15-18/0185r1.**

**Yes: 3 No: 0 Abstain: 1**

1. The group agreed that contributions to the MAC should be made in separate documents following the structure of Section 5.
2. Alternatively, comments can also be made against D2, to be released by the end of May, that would represent the proposed changes to the baseline text. As an example, a comment against D2 would be to move part of the Annex to a particular section in the next draft.
3. The agenda was modified to reflect the addition of the discussion of the timeline.
4. There was a discussion around the timeline (doc. 15-17/0288r3) to try and accelerate the development. The committee agreed to continue working on Draft D2.0 and provide a more complete D3.
5. The committee agreed to hold 8 meetings in the July Plenary session.
6. There was a discussion about hosting teleconferences to address before the July meeting. It was agreed that these conference calls will be held with 7 days notice.
7. The key list of actions that need to be completed before the next meeting in July include:
	1. Simulation results for the PM-PHY, LB-PHY and HB-PHY
	2. Comments against the PM-PHY (doc. 15-18/0003r6) and LB-PHY (doc. 15-18/0168r3)
	3. Text proposals on MAC general frame structure
	4. Text proposals on HB-PHY
8. Conference calls to be arranged for:
	1. May 21 between 13:00 – 14:00 CET
	2. June 5 between 13:00 – 14:00 CET
	3. June 25 between 13:00 – 14:00 CET
9. The conference call dial-in details have been shared on the TG13 email reflector.
10. The group discussed the new references added in doc. 15-18/0003r6 in particular talking about the coding gain that should be seen from an 8B10B encoder.
11. The committee is in recess until Wednesday, PM1.

**Wednesday, 09 May 2018 – PM1**

Attendance:

* Volker Jungnickel (HHI) – Chair
* Sang-Kyu (ETRI)
* John Li (Huawei)
* Tuncer Baykas (Mediopol University)
* Nikola Serafimovski (pureLiFi)
* Chong Han (pureLiFi)
* Ryan Mennecke (JHU-APL)
* Christophe Jurczak (Lucibel)
1. Chair called the meeting to order.
2. John Li (Huawei) presented doc. 15-18/0232r0.

The discussion was to include a table that would show the bits and the meaning of each format. Participants are required to provide their MAC proposals in a different document/submission using doc. 15-18/0232r0 as a template.

1. The committee agreed to issue a call for proposals for the MAC text based on doc. 15-18/0232r0 as a basis.
2. Chong Han (pureLiFi) presented doc. 15-18/0168r2.

Q: What is the source of the PN-sequence and the source of the filter.

A: It is similar to a one used in 802.11.There was a request to do evaluation to see the peak-to-average-power ratio (PAPR) of the PN-sequence.

Q: Why there is an appended advanced modulation header?

A: It is because more information was needed and shifted into a second OFDM symbol.

Q: Why there is no HCS field?

A: It is not needed.

C: The technical Editor mentioned that the HCS is quite common in many standards.

Q: What is the “High reliability MAC header”. The naming should be changed because the “MAC header” is not appropriate for this functionality.

A: Will be changed in a revised version of the document.

Q: Why there is again a “Length of pkt” field? This information may be redundant considering the existing the information in the Basic PHY Header.

A: This is necessary because it reduces the computational complexity.

Q: Should some of the fields defined in the PHY be defined in a common fashion for all of the PHYs to achieve a standard interface to the MAC?

A: There is no need for agreement when there are multiple PHY modes, as long as all of the relevant information elements are defined in the relevant parts of the document. The example of 60 GHz was given where there are two entirely parallel MAC/PHY definitions. There has been no consensus on this point.

There has been further discussion on the pulse shaping sequence.

John Li (Huawei) would like to revisit doc. 15-17/0579r0. Nikola and Chong will provide feedback tomorrow (Thursday, 10 May) against the due actions.

1. Tuncer Baykas (Medipol University) presented doc. 15-18/0182r0.

Q: Is there interest to have support for the relaying in the PM PHY and HB PHY in addition to the LB-PHY?

A: Yes. Volker will follow up with Tuncer about this.

1. Sang-Kyu Lim (ETRI) presented doc. 15-18/0235r0. This is a response to questions why the uncoded data seems to have better performance than the 8B10B coded data.

Q: Why the 8B10B does not provide any improvement in the context of error correction.

A: The role of 8B10B is not for error correction. Instead, it is added to minimize the number of consecutive `1’s and `0’s which in turn minimizes the baseline wander. The simple encoding/decoding in this case will not provide any coding gain as a “traditional” implementation. The group was satisfied by this answer on a previous discussion and there is no need for further clarification on this point.

1. Meeting is in recess.

**Wednesday, 09 May 2018 – PM2**

Attendance: 6

* Volker Jungnickel (JHUAPL)
* Dan Chew (JHUAPL)
* Chong Han (Purelifi)
* Sang-Kyu Lim (ETRI)
* John Li (Huawei)
* Tunçer Baykaş (Medipol University)
1. The meeting was called to order.
2. Discussion of PM PHY text in doc. 15-18-003/r6 was the first agenda item.
3. Chair stated to keep providing various simulations to aid in the adoption of the pulse modulation PHY types.

1. PM PHY Decision #1

Can TG13 agree on the preamble lengths as defined in doc 15-18-0003/r7?

**Yes.**

The consensus of the group was to use a 64 bit preamble length (extended gold sequence [A32, A32]) for the 2-PAM and 8B10B line coding and the sequence length 96, 192, and 384 in case HCM(1,N) with N=4, 8, 16. The basic mode is using the longest sequence as it is the most reliable choice. Hence the group has decided that in blind detection and association the basic mode that should utilize the preamble length of 384 to properly support HCM(1,16) is always used in the beacon. Devices can suggest and use other MCS as soon they are aware that SNR is higher.

1. PM PHY Decision #2

Can TG13 agree on the channel estimation sequence defined in doc 15-18-0003/r7?

**Yes.**

The group has decided to accept the channel estimation sequences proposed in the document. A request was made to provide more channel estimation simulations using the proposed sequences to collect the data.

1. PM PHY Decision #3

Can TG13 agree on the header defined in doc. 15-18-0003/r7?

Postponed the question.

1. PM PHY Decision #4

Can TG13 agree on the optional fields defined in doc. 15-18-0003/r7?

**Yes**

1. PM PHY Decision #5

Can TG13 agree on the payload defined in doc. 15-18-0003/r7?

This question has been postponed.

1. Volker raised a question how to use the timestamp field in the control/beacon packets proposed PM PHY document or should it be removed and put into the MAC layer? The timestamp field currently resides in the MAC therefore it should be removed from the PM PHY proposal into the MAC.

Q: In the header it looks like we are freezing the number of sub-carriers to 16 for HCM, is this by design or a mistake in table 3 Descriptor for MCS?

A: This is a misunderstanding. If you choose 0 there is no modulation and the maximum is 15 HCM codes. Also, a change to make the range from 0-15 to 1-15 to make it more clear. Changes to table 3 were made to at suggestion to make the implementation more clear and free up a bit in the use case of not implementing HCM.

Q: Is the Hadamard Code unipolar or bipolar, it is not defined?

A: The comment has been noted in the document to help clarify and describe the Hadamard Code as unipolar.

1. Meeting is in recess.

**Thursday, 10 May 2018 – AM1**

Attendance: 6

* Volker Jungnickel (JHUAPL)
* Dan Chew (JHUAPL)
* Chong Han (Purelifi)
* Sang-Kyu Lim (ETRI)
* John Li (Huawei)
* Tunçer Baykaş (Medipol University)
1. The meeting was called to order.
2. The Chair was approached by a committee member and asked the group to modify the agenda in order to allow members of the group to attend the WNG meeting in 802.11 and hear interesting contributions there. He run a straw poll where a majority in the room was in favor of this. All remaining tasks will be processed in PM1.
3. The meeting was recessed until PM1.

**Thursday, 10 May 2018 – PM1**

Attendance: 6

* Volker Jungnickel (JHUAPL)
* Dan Chew (JHUAPL)
* Ryan Mennecke (JHUAPL)
* Chong Han (Purelifi)
* Sang-Kyu Lim (ETRI)
* John Li (Huawei)
* Tunçer Baykaş (Medipol University)
1. The meeting was called to order.
2. The Chair asked to check attendance.
3. The first point on the agenda was to finish comment resolution. The group resolved all remaining comments. The results uploaded in doc. 15-18-0088/r2.
4. The Technical Editor run the discussion on doc. 15-17-0579/r0 regarding some questions which remain to be answered regarding the MAC. As shown on slide 18 and 19 the decisions and actions still needed are reflected in a revised version 15-17-0579/r1 uploaded onto the Mentor.
5. Next point was the intended Agenda for July.
* Report on 3 teleconferences and make decisions
* Finalize text proposal on LB PHY
* Present HB PHY proposal
* Present TG13 MAC text proposals
* Discuss control frame format and types
* Discuss management frame formats and types

Proposers should provide text proposals and a comment against D2 that proposals shall be included in D3.

1. The meeting adjourned until San Diego.

**Thursday, 10 May 2018 – PM2**

The meeting slot has not been used.