**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
| Title | Minutes of TG13 Ad-hoc Meeting July |
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| Source | Volker Jungnickel (HHI) | Voice: [ ]Fax: [ ]E-mail: [ ] |
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| Abstract | [Minutes of July 2017 Ad hoc Session]  |
| Purpose | [Inform TG13 about most recent work.] |
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**Task group 802.15.13 met for 5 meetings during the July 2017 Ad-hoc meeting at Fraunhofer HHI, Einsteinufer 37, 10587 Berlin, Germany.**

**Meeting #1, Monday 17 July 2017, AM2, 10:30 – 12:30**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Mohammad Noshad (VLNComm)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)
* Jonas Hilt (HHI)

The meeting was called to order by Volker Jungnickel (Fraunhofer HHI).

Volker Jungnickel presented **doc. 15-17-0342r1**.

Patent slides are shown and the rules to attendance are explained.

Agenda is provided in **doc. 15-17-0342r1** ; it has been discussed and approved.

Sang-Kyu Lim (ETRI) presented **doc. 15-17-0445r0** and **doc. 15-17-0446r0** on flicker mitigation and dimming support in 802.15.7. The participants discussed the schemes and their complexity in order to get a better understanding. Any discussion was postponed after hearing all contributions.

Jonas Hilt presented **doc. 15-17-0448r0** on the Fraunhofer OOK implementation. There were minor errors corrected in version **doc. 15-17-0448r1** uploaded onto the Mentor.

Meeting recessed until Afternoon.

**Session #2, Monday 17 July 2017, PM1, 13:30 – 15:30**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Mohammad Noshad (VLNComm)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)
* Jonas Hilt (HHI)

The meeting was called to order by the Chair Volker Jungnickel (Fraunhofer HHI).

Mohammad Noshad (VLNComm) presented **doc. 15-17-0450r0.**

Group discussed the proposed HCM technique and found it useful to support multiple users as well as to reduce the coding rate while keeping the Optical clock rate constant.

Meeting was recessed until late afternoon.

**Session #3, Monday 17 July 2017, PM2, 16:00 – 18:00**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Mohammad Noshad (VLNComm)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)

The meeting was called to order by the Chair Volker Jungnickel (Fraunhofer HHI).

The group discussed the structure of the new section on Pulsed Modulation PHY.

There are two separate functionalities to be distinguished. First, there is a communications functionality and, when using visible light, second, there may be the need for an additional dimming functionality. Joint implementation is possible in various ways.

One particular way is that the dimming is controlled via a bias current which is constant over time and where there is an output signal for the data transmission (denoted as modulation signal) which is orthogonal to the constant bias signal. This property of the modulation signal can be realized using several techniques, e.g. by using line coding (e.g. Manchester coding, 4B6B or 8B10B) or Hadamard Coded Modulation (HCM)) as described in **doc. 15-17-0450r0**. At the transmitter, the bias and the modulation signal are then just added.

In this particular way, the receiver does not even need to know the dimming level in order to decode the data from the compound signal received after the PD, and if needed, the transmitter is free to set the dimming level independent of the receiver. Accordingly, there is no need for signalling fields telling the receiver the dimming level used at the transmitter, or an accordingly used parameter setting of the modulation scheme.

Proposed new structure of Section 10

10 Pulsed Modulation PHY

10.1 Forward error correction

10.2 Modulation signal

10.3. Line coding

10.4. Hadamard coded modulation

10.5. Dimming support

Task until Wednesday is to think about reasonable parameter settings like in Table 107 in D0.

The meeting was recessed until Wednesday.

**Session #4, Wednesday 19 July 2017, AM1, 10:30 – 12:30**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Mohammad Noshad (VLNComm)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)

The meeting was called to order by the Chair Volker Jungnickel (Fraunhofer HHI).

The attendees discussed principle issues for writing a joint proposal document; latest uploaded version is 15-17-454-01.

It was argued that in 802.15.13, the two functions of data transmission and dimming should in general be decoupled from each other, which would greatly simplify both, the PHY and MAC complexity. Currently, Chapter 4.4 contains 7 different ways to implement dimming. This should be reduced.

It was argued that for dimming one can control three parameters: the bias, the modulation index and the pulse width. All of them can be regarded as functions between the PHY and the analog optical frontend. Accordingly, two schemes have been proposed that are considered optional in general. These are

1. dimming based on bias current (also taking the modulation index into account)
2. dimming based on pulse width

The two schemes shall be described in the descriptive part of the standard in revised section 4.4.1, which should be rewritten entirely.

The meeting was recessed.

**Session #4, Wednesday 19 July 2017, PM1, 13:30 – 16:10**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Mohammad Noshad (VLNComm)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)

The meeting was called to order by the Chair Volker Jungnickel (Fraunhofer HHI).

For Section 10, the group defined ageneral transmitter architecture, consisting of the FEC, the line encoder and the symbol mapper.

For the FEC, a RS code is used but differently parametrized in the existing implementations. Proposals are requested to find a unified parametrization which takes into account the needs of the existing use cases (short/long block length) and allow low complexity.

For the line enccoder, depending on the modulation scheme, 8B10B is proposed for OOK and 5S6S for 4-PAM. Instead of using a line code, the HCM method described in **doc. 15-17-450-00** can be used. However, this was considered part of the symbol mapper, in order to avoid any confusion. Hence no line code will be used in combination with HCM.

For OOK, transmitter and receiver could even be implemented even without a DAC and ADC allowing low-power/low-cost implementation. It was also discussed that more opportunities for rate adaptation with fixed optical clock rate could be achieved by using a small number of fixed code rates with RS(n,k) and then applying an additional repetition code.

PAM and HCM modes need either a DAC or multiple equally directed LEDs in a panel at the transmitter to emulate multiple signal levels that may occur. At the receiver, an ADC is needed anyway. HCM allows fine-granular control of the code rate. At the MAC layer, different HCM codes could be assigned to different users.

The group described the different parts of the transmitter in the document and developed a table to replace Table 107 in D0 of TG13. This table just reflects the status quo of different implementations discussed in the four input documents **doc. 15-17-445-00, doc. 15-17-446-00, doc. 15-17-448-01** and **doc. 15-17-450-00** and needs to be further unified.

Proposals shall be included in a revised version of the document **doc. 15-17-454-01** and be uploaded onto Mentor. In the revised versions, track changes shall be activated so that for any change it can be followed what has been changed and by whom. This is required for efficient work on the document while keeping the process fully transparent. TG13 shall be informed about any change via the email reflector. Discussion about the Pulsed Modulation PHY shall be finalized during the Kona meeting with the goal to update the text in D1, accordingly.

The meeting was adjourned until the Kona session in September.