**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | May IEEE802.15.13 Minutes | |
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| Source | Nikola Serafimovski (pureLiFi)  Volker Jungnikel (HHI) | Voice: [ ] Fax: [ ] E-mail: [ ] |
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| Abstract | [Minutes of May 2017 Interim Session] | |
| Purpose | [Description of what the author wants P802.15 to do with the information in the document.] | |
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**Task group 802.15.13 met for 10 sessions during the May 2017 meeting.**

**Session #1, Monday 08 May 2017, AM 2 (10:30 – 12:30)**

Volker Jungnikel (HHI) – Chair

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)
* Rick Roberts (Intel)
* Huan-Bang Li (NICT)
* Thomas Kürner (TU Braunschweig)
* Bob Heile (WiSun Alliance)

The meeting was called to order by Volker Jungnickel (Fraunhofer HHI) who was appointed as the TG Chair by the WG chair Bob Heile (WiSun Alliance) and confirmed by the TG members.

Li Qiang-John (Huawei) was appointed by the TG chair as Technical Editor.

Nikola Serafimovski was named as Vice-Chair for the group.

Nikola Serafimovski (pureLiFi) and Li Qiang-John (Huawei) were named as co-secretaries, depending on availability.

Agenda was discussed and confirmed **doc. 15-17-0285-00-0013r0**.

The Chair reviewed the history of the new 802.15.13 Task Group. It is a spin-off from the 802.15.7m Task Group now having an own PAR on Multi-Gigabit OWC that was confirmed after the Vancouver meeting. This enables the TG to develop now an own specification for Li-Fi. It is intended to leverage existing work from TG7 and TG7m that is useful into this direction.

Samuel asked the difference between 802.15.13 and the LC TIG in 802.11. The Chair explained that the work being done in 802.15 is effectively a continuation of the efforts within the 802.15.7r1 on Li-Fi and with a particular focus on specialist industrial networks where the product can be delivered very quickly and there are less demanding constraints regarding cost and low energy consumption. The work within 802.11 is envisioned focusing on the mass market deployment of Li-Fi which requires additional considerations for low cost and low energy.

Nikola explained that the two groups use different MACs and are likely to be published at a different time with different ecosystem support. It was also stated that TG13 has a running project in 802.15 with the objective to finish mid of 2018, while the LC TIG in 802.11 has the objective currently to raise the attention of Wi-Fi people for this new technology targeting future approval as a project also within 802.11 that will most likely be finished in the next decade if it should be approved.

The Vancouver meeting minutes **doc. 15-17-0263r0** were approved.

The chair discussed the suggested timeline for SG MG (doc. 15-17-0218r2) as a baseline timeline for TG13. The document was revised after discussion in the TG and following the suggestion of the Technical Editor to allow more time to review drafts carefully and make comments. The new agenda will be uploaded and regularly updated under the TG13 mentor reflector as **doc. 15-17-0285r1**.

Nikola presented draft wording that the IEEE 802 should submit to the ITU-R SG1 WP1A to provide an official position of IEEE 802.

Meeting recessed until PM 2.

**Session #2, Monday 08 May 2017, PM 2 (16:00 – 18:00)**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)
* Rick Roberts (Intel)
* Huan-Bang Li (NICT)
* Thomas Kürner (TU Braunschweig)
* Bob Heile (WiSun Alliance)

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

Following the agreed upon agenda, comment resolution against D1 of TG7m was started. This was led by the Technical Editor, Li Qiang-John (Huawei) on **doc. 15-17-0297r0**.

The meeting was recessed until Tuesday, AM1.

**Session #3, Tuesday 09 May 2017, AM 1 (8:00 – 10:00)**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)
* Rick Roberts (Intel)
* Huan-Bang Li (NICT)
* Thomas Kürner (TU Braunschweig)

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

Following the agreed upon agenda, comment resolution against D1 of TG7m was continued led by the Technical Editor, Li Qiang-John (Huawei). Details are contained in **doc. 15-17-0297r0**.

In the second part of the meeting, a discussion was conducted what PHYs shall be maintained in D0 of TG13 and which to remove. The discussion about this topic was moderated by the chair and technical reasons for keeping or removing PHYs were discussed.

Summarizing this discussion, it was found out that 3 PHYs should be enough to cover the whole objectives of TG13, which are very wide in respect to the achievable data rates from 1 Mb/s to 10 Gb/s and the different use cases to be covered.

The 3 selected PHYs are

* PHY II, because it intends to reach up to 96 Mb/s with very limited complexity using OOK, and VPPM in case dimming needs to be supported using the visible light spectrum. Unlike other selected PHYs, PHY II of TG7 uses a scalable bandwidth up to around 100 MHz but has in general a rather limited spectral efficiency. PHY II could be implemented even without a DAC or ADC and is thus useful for implementations with very low power consumption. It suitable to achieve very robust optical wireless communication at moderately high data rates and is considered particularly useful for applications in the Industrial Internet of Things (IIoT) which is also in the scope of TG13. It was discussed that the committee is unaware about dedicated implementations of PHY II from IEEE 802.15.7-2011 so far, but two committee members mentioned that they have similar PHYs implemented in real time as PoC in their labs which are however not fully compliant with PHY II of TG7. The intention in TG13 is now to check the existing PHY II from TG7m against these existing implementations as part of the work in TG13 and to revise it accordingly so that an evolved PHY II will be defined by TG13 in its draft that has been proven by these existing implementations. Moreover, at least one variant of PHY VII has been realized with low-enough power consumption so that the end user device could be powered for hours by a standard Li-Ion rechargeable battery.
* PHY VII (low-bandwidth PHY), although it intends to the same range of data rates like PHY, it does this in a complementary manner. The use of OFDM-based transmission enables the use of spectrally efficient modulation formats, such as 16-QAM and 64-QAM, so that a moderately high data rate is achievable within this given bandwidth limitations. The price is that an ADC and DAC are always needed, but apart from this the analogue driver can be very energy-efficient what is useful in battery-powered end user devices. Moreover, it is known that one committee member has an existing real-time implementation of this PHY in his labs so that the content of the specification has been sufficiently tested by an existing PoC. Moreover, PHY VII has already been realized with low-enough power consumption so that the end user device could be powered by a standard USB connector.
* PHY VIII (high-bandwidth PHY), the PHY is based on the ITU-T recommendation G.hn-2015, originally developed for fixed media like powerline, twisted pair and coax. The current specification based on DCO-OFDM allows both, the use of high bandwidth up to 1 GHz and the use of spectrally efficient modulation formats, up to 4096 QAM together with closed-loop adaptive bit-loading. Moreover, LDPC codes are being used, and commercially available chipsets already have implemented selective retransmissions which keep latency low. Hence, error protection is excellent so that this PHY can cope very well with typical clipping effects which occur when OFDM is used over optical channels. One advantage of the PHY VIII is that it can be realized with several commercially available chipsets. One committee member already achieved almost 1 Gb/s in a real-time prototype using standard high-power LEDs in 100 MHz bandwidth. The committee is also aware that another company recently achieved similar results in its prototypes. Committee members have previously demonstrated in TG7m by means of simulations over the agreed upon channel model that 10 Gb/s are achievable using PHY VIII in two ways: Either by using up to 1 GHz bandwidth achievable only with lasers, instead of LEDs, or by using MIMO schemes with up to 8 transmitters and receivers.

The other PHYs will be removed because either out of scope (PHY I, PHY IV-VI) or redundant in terms of achievable data rates (PHY III) but having higher complexity

The content of the above summary also contains contributions made in the following meeting. The chair ensured that discussion was conducted in a fair manner and only based on the technical arguments reported above. Because the technical discussion has been in parts controversial, the committee has made a motion to fix its final conclusions at the end.

The meeting was recessed until Tuesday AM2.

**Session #4, Tuesday 09 May 2017, AM 2 (10:30 – 12:30)**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)
* Rick Roberts (Intel)
* Huan-Bang Li (NICT)
* Thomas Kürner (TU Braunschweig)

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

Following the agreed upon agenda, comment resolution against D1 of TG7m was continued led by the Technical Editor, Li Qiang-John (Huawei). Details are contained in **doc. 15-17-0297r0**.

Second part of the meeting the discussion on what PHYs to maintain in D0 of TG13 and which to remove has been continued. The following a motion was made indicating the decision is finally agreed upon unanimously within the task group. Via this motion, the Technical Editor is authorized to delete the respective sections from the draft. The decision regarding the MAC functions related only to the removed PHYs has been postponed and will be made in conjunction with the comment resolution against D0 of TG13 during July and September sessions.

**Motion #1: TG13 moves that the following sections in D1 from TG7m will be removed in D0 of TG13**

**10. PHY I**

**12. PHY III**

**13. PHY IV**

**14. PHY V**

**15. PHY VI**

**Moved by Nikola Serafimovski, Seconded by Li Qiang**

**Motion was approved by unanimous consent.**

The meeting was recessed until Tuesday PM2.

**Session #5, Tuesday 9 May 2017, PM 2 (16:00 – 18:00)**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)

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

Following the agreed upon agenda, comment resolution against D1 of TG7m was continued led by the Technical Editor, Li Qiang-John (Huawei) until comment #148. Details are contained in document **doc. 15-17-0297r1**.

The meeting was recessed until Wednesday AM1.

**Session #6, Wednesday 10 May 2017, AM1 (8:00 – 10:00)**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)

The meeting was called to order by the Chair Volker Jungnickel (Fraunhofer HHI). The minutes of the previous meetings were discussed.

Following the agreed upon agenda, comment resolution against D1 of TG7m was continued led by the Technical Editor, Li Qiang-John (Huawei). Details are contained in document **doc. 15-17-0297r2**.

The committee discussed that any reference to external standards should be avoided and exact specifications should be added. Nikola Serafimovski mentioned that in his understanding, a Letter of Assurance may be needed for anything that is submitted that is needed for implementation.

The chair will check the terms and conditions regarding potential IP considerations that may be taken over from the ITU-T G.hn base-line document into the IEEE 802.15.13 specifications.

The meeting was recessed until Wednesday PM1.

**Session #7, Wednesday 10 May 2017, PM 1 (13:30 – 15:30)**

Attendees:

* Volker Jungnickel (Fraunhofer HHI)
* Li Qiang-John (Huawei)
* Mohammad Noshad (VLNComm)
* Nikola Serafimovski (pureLiFi)
* Tae-Gyu Kang (ETRI)
* Sang-Kyu Lim (ETRI)

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

Following the agreed upon agenda, comment resolution against D1 of TG7m was finalized led by the Technical Editor, Li Qiang-John (Huawei). Details are contained in document **doc. 15-17-0297r1**. The completed comment resolution is provided in **doc. 15-17-0285r2.**

The committee discussed the need for orthogonality between the various PHYs from 802.15.7r1 and 802.15.13. Volker will raise the topic with Yeong Ming Jang.

The committee discussed the schedule and motions presented in **doc. 15-17-0285r1.**

**Motion:**

**TG13 moves that**

1. **The Technical Editor is authorized to correct all comments against D1 of 802.15.7m and produce D0 of 802.15.13 which will form the basis of further work in TG13.**
2. **Volker Jungnickel is authorised to provide a corrected FrameMaker version of Section 17 from D1 of 802.15.7m to the Technical Editor.**
3. **It is planned to make D0 of 802.15.13 available before June 7.**
4. **Comments against D0 of 802.15.13 received until 2 July 2017 meeting will be considered at the July plenary meeting. Further comments can be submitted until August 27.**

**Moved by Volker Jungnickel**

**Seconded by Nikola Serafimovski**

**Approved by unanimous consent.**

Meeting adjourned until the July 2017 session in Berlin.