**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **TG4q ULP May 2014 Meeting Minutes** | |
| Date Submitted | 11 June 2014 | |
| Source | [Jinesh Nair] [Samsung.] | E-mail:[jinesh.p@samsung.com] |
| Re: | Ultra Low Power amendment to IEEE 802.15.4 | |
| Abstract | TG4q ULP Meeting minutes | |
| Purpose | Meeting minutes | |
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**Task Group ULP Meeting Monday, 12 May 2014 PM2 session:**

**AM1 session:**

1. Chair (Shahriar Emami) called session to order.

2. Opening report (DCN: 15-14-0293-01-004q) for ULP presented by Chair

3. March 2104 meeting minutes (DCN: 15-14-0194-00-004q) is approved

4. Teleconference call minutes (DCN: 15-14-0230-00-004q) and (DCN: 15-14-0276-00-004q) are approved.

4. ULP Opening report (DCN: 15-14-0293-01-004q) and Agenda (DCN: 15-14-0231-01-004q) presented by the Chair.

Motion to approve the meeting minutes and agenda and opening report passed unanimously

Moved by: Frederik Beer (FAU/IIS)

Seconded by: Chunhui (Allan) Zhu (Samsung)

5. Frederik went through the ULP-GFSK part of the merged draft. Questions regarding MAC, transmission power control, synchronization complexity related issues etc. were discussed.

6. Chandrashekhar Thejaswi went through the ULP-TOOK part of the merged draft. Questions for clarification were asked on the draft regarding Table 4, one’s complement part in Fig. 5, implementation aspects of the phase changes, the RF signal representation etc. were discussed.

7. James Gilb asked for clarifications and justification to all the parties of the merged draft. They were mainly

1. What specifically about the PHYs that were selected has characteristics that enable low TX and RX power?
2. How does the modulation design enable lower power solutions?
3. Why is there the added complexity and power use of FEC, interleaving, etc. to the design?

The discussion that followed were on the following points

1. James: The need for FEC and how can this be low power?

Ans: Frederik: FEC encoding is not very complex and the decoding complexity can be handled by a co-ordinator in an asymmetric link. Also low transmission power can be facilitated due to the significant SNR gains possible.

CT: In the case of ULP-TOOK, only low complexity block FEC is used which is typical to many low power standards.

1. James: What is significantly different in the ULP-GFSK PHY when compared to 15.4g

Ans: Frederik/Henk: The preambles, the FEC exploiting the asymmetric link, variable rate GFSK and MAC related changes are the key differentiators.

1. James: There are many editorial errors in the draft and these needs to be addressed but before that the important technical problems have to be addressed. For ex. left/right is a wrong usage and before/after is preferable.
2. James: There is no specific advantage of using TOOK modulation for low power and the proposed modulation does not bring in significant advantage compared to other modulations.

Ans: Ivan: Ternary modulations are used in ISO14443 based systems and are known to be extremely low power. Theoretically, FEC, spreading and the modulation gives around 10 dB gain but in practice it is possible to get around 6 to 7 dB gain with such systems. Millions of such devices based on this are available in the market.

Jinesh: We use the modulation which enables the use of a receiver like the SRO which has significantly lower power consumption compared to other receivers like DC receiver and Low-IF receiver. But the modulation is not restrictive for use with other RF front ends. We have published the low power results in the proposal which shows advantages at the transmitter and also the receiver.

CT: The modulation supports both coherent and non-coherent receivers. For ULP communication using receivers like SRO the -1 and 1 in the modulations are treated as 1 only. But for applications that require range/SNR the modulation supports coherent reception as well. Also, the correlation properties of the sequences used for modulation are well suited for such simultaneous coherent as well as non-coherent reception.

**Task Group ULP Meeting Tuesday, 13 May 2014 AM1 session:**

1. Chair (Shahriar Emami) called session to order.

**2. Frederik Beer made a presentation on the topic titled “Validation and Verification Task Force Proposal” (DCN: 15-14-0303-01-004q)**

*Pat:* This is a very good suggestion and actually helps in the speeding up the time for system evaluations thus assisting the implementers of the standard. However this needs further discussions to get all parties on board.

*Jinesh:* This is good but needs sharing of simulation codes and merging them to create a common framework. This may be time consuming and can actually delay the standardization. Also this cannot be made mandatory.

*Beer:* It can be done in a manner that standardization is not affected and need not be mandatory. The presentation was done to get the thoughts of various members in the 15.4 community and act accordingly after due discussions.

**3. Shahriar Emami made a presentation on the topic titled “Improving Packet Energy Efficiency Using ULP Mode” (DCN: 15-14-0301-01-004q)**

**4. Pat Kinney made many suggestions regarding the draft and technical points to assist the group in strengthening the merged draft.**

The key points discussed were

1. Comparison and benchmark with legacy IEEE 802.15.4 DSSS PHY and other low power PHYs like 6LowPAN, IETF, BTLE etc.
2. Short packets are attractive but one needs to consider the overheads added by upper layers before defining what a short packet is. Also each time a packet is transmitted there are associated overheads. So sometimes longer packets are also good. At the same time 2K octets are too long and are undesirable.
3. Have a system concept and description which can be in the informative annexure which can be later deleted. This will help the merged proposal in the letter ballot phase when people look for justification for the modifications and new PHY. Please look at system description and implementation and this can be included as informative annex and removed in the later versions.
4. Please give a clear justification for the new standard (raison d’etre). For ex. coin cell, energy harvesting etc.
5. Please look at interoperability,
6. Are there any MAC tricks? Better integration with MAC is the best place to save energy
7. Please describe the applications and the features in the new PHY that addresses the low power requirements of the said applications.
8. Please comment on the security aspect. Do we need FCS? In industry applications there are too many false alarms. Do we need FCS when we do security?
9. Do we need so many data rates? There needs to be a significant justification.

**Task Group ULP Meeting Wednesday, 14 May 2014 AM1 session:**

1. Chair (Shahriar Emami) called session to order

2. The chair presented a consolidated list of comments received and that are important to be addressed. The tasks associated with addressing these were specifically assigned to different members for both ULP-GFSK and ULP-TOOK.

3. The editors were selected for the draft for Letter Ballot. Allan Zhu was selected as the editor. Chandrashekhar Thejaswi was selected as the sub-editor for ULP TOOK and Frederik Beer was selected the sub-editor for ULP GFSK.

**Task Group ULP Meeting Thursday, 15 May 2014 AM1 and AM2 session:**

1. Chair (Shahriar Emami) called session to order.

2. The to-do list was presented again and discussed in detail. The way forward was discussed. Based on this, the time-lines for future action and conference calls were planned.

3. TG4q meeting adjourned.

Motion to adjourn the meeting

Moved by: Frederik (FAU/IIS)

Seconded by: Chandrashekhar Thejaswi (Samsung)