Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [Possible PHYs for upcoming TG4m]
Date Submitted: [22 July, 2011]
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Re: [802.15.SG 4TV]

Abstract: This contribution is prepared to introduce possible PHYs for upcoming TG4m.

Purpose:

Outline

- The goal of this document is to discuss possible PHYs of upcoming TG4m for WPAN operation in the TV white space
- This document includes
  - Updated PAR scope
  - Revisiting 15.4 PHYs and its alternative PHYs
  - Possible PHYs for TG4m to satisfy the PAR scope

PAR Scope

- This amendment specifies a physical layer for 802.15.4 meeting TV white space regulatory requirements in as many regulatory domains as practical and also any necessary MAC changes needed to support this physical layer. The amendment enables operation in the available TV band white spaces, supporting typical data rates in the 40 kbits per second to 2000 kbits per second range, to realize optimal and power efficient device command and control applications.

Possible PHYs for TG4m

- The TG4m PHY
  - Can be taken from 802.15.4 PHYs or its alternative PHYs: for reference, 11af PHY comes from 802.11-2007
  - Can be a new PHY to satisfy the PAR scope

15.4 PHYs and Its Alternative PHYs

- 802.15.4
  - 2450MHz PHY
    - 4 bits are mapped into 32-chip sequence
    - O-QPSK Modulation
    - Data rate: 250Kbps (Chip rate: 2Mchip/s)
    - Channel BW: 5MHz
  - 868/915 MHz BPSK PHY
    - 20kbps in the 868MHz band
    - 40kbps in the 915MHz band
    - 1 bit is mapped into a 15-chip PN sequence
    - Differential encoding and BPSK modulation

15.4 PHYs and Its Alternative PHYs

- 802.15.4: continued
  - 868/915 MHz O-QPSK PHY
    - 100kbps in the 868MHz band
    - 250kbps in the 915MHz band
    - 4 bits are mapped into 16-chip sequence
    - O-QPSK Modulation
    - Chip rate in the 915Mhz band: 1Mchip/s
    - Channel BW in the 915Mhz band: 2MHz
    - Some parts of this PHY spec. are included in 15.4g O-QPSK PHY

15.4 PHYs and Its Alternative PHYs

- 802.15.4a
  - Impulse Radio (IR) UWB
    - Scalable data rates: 0.11Mbps~27.24Mbps
    - Signal BW: ~500MHz
  - 2450MHz Chirp Spread Spectrum (CSS)
    - Data rates: 250Kbps & 1Mbps
    - Signal BW is larger than 6MHz
  - Due to the large signal BW, it is hard to accommodate 4a PHYs in one TV band

15.4 PHYs and Its Alternative PHYs

- 802.15.4g
  - MR-FSK, MR-OFDM, MR-O-QPSK
  - Scalable data rates: 4.8Kbps ~ 800Kbps
  - It is easy to extend the data rate up to 2Mbps
  - Channel bandwidth is small compared with one TV band.
- Other 15.4x
  - Under standardization

⇨ ***Among 15.4 PHYs and its alternative PHYs, it would be desirable to extend 15.4g PHYs for TG4m.***

Possible PHYs for TG4m

- When considering extension of 15.4g PHYs for TG4m
  - It is not efficient to adopt the single PHY since the data rate range is from 40Kbps to 2Mbps.
- For example: dual PHY is possible
  - Low rate PHY covering 40Kbps~several hundreds of Kbps
    - 15.4g FSK PHY would be a good solution
    - Low rate & Low complexity
  - High rate PHY covering several hundreds of Kbps ~ 2Mbps
    - 15.4g OFDM PHY would be a good solution
    - High rate & High performance

Summary

- By revisiting 15.4 PHYs and its alternative PHYs
  - Extension of 15.4g PHYs for TG4m would be one of good solutions to satisfy the PAR scope
- A new PHY also can be proposed for TG4m