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

Submission Title: [Considerations for Low Data Rate IR-UWB PHY in IEEE 802.15.8]
Date Submitted: [January 2013]
Source: [Igor Dotlic, Huan-Bang Li, Marco Hernandez, Ryu Miura] Company [NICT]
Address [3-4 Hikarino-oka, Yokosuka, Kanagawa, Japan]
Voice:[+81-468475066], FAX: [:[+81 468475431], E-Mail:[dotlic@nict.go.jp]

Re: [Information and discussion on UWB]

Abstract: [Discussion on different aspects of the IR-UWB PHY in IEEE 802.15.8]

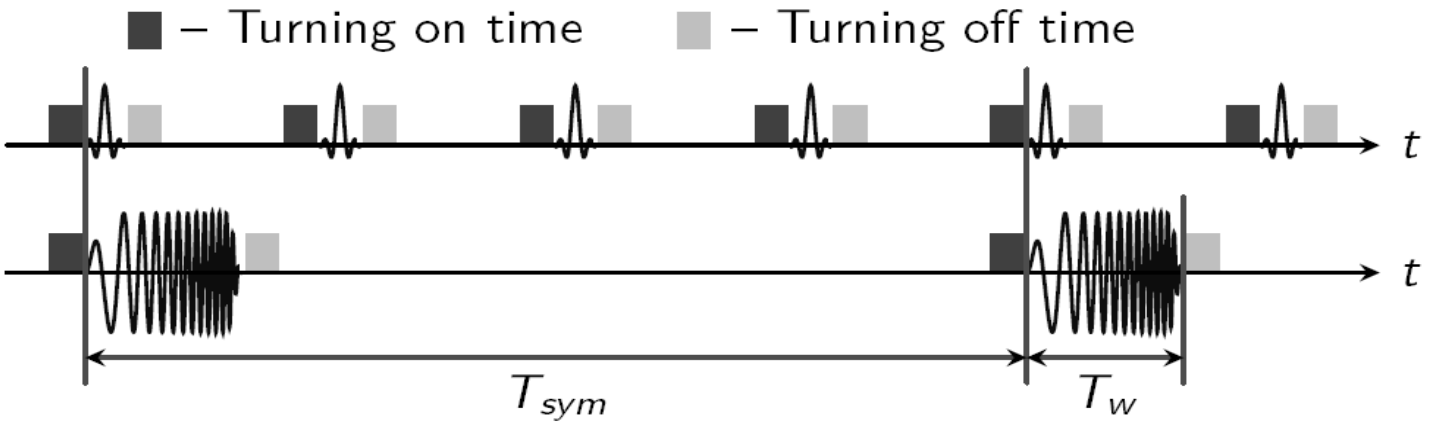
Purpose: [This document is to provide a general review of IR-UWB for PAC]

Considerations for Low Data Rate Impulse Radio Ultra-Wideband (IR-UWB) PHY in IEEE 802.15.8

Igor Dotlic
Huan-Bang Li
Marco Hernandez
Ryu Miura

National Institute of Information and Communications Technology (NICT), Japan

IR-UWB Signaling symbol structures



- Upper: Classic IR-UWB signaling having several short-pulse chips per symbol.
- Lower: Transmitting one continuous waveform per symbol (used in 15.4a and 15.6).

IR-UWB Signaling strategies (cont'd.)

Several short-pulse chips per symbol

- Pros: Precise localization without need of correlator and without exact knowledge of transmitted pulse shape, low Tx complexity.
- Cons: Poorer performance of low-complexity energy detection Rx, not efficient duty cycling.

IR-UWB Signaling strategies (cont'd.)

- Transmitting one continuous waveform per symbol
  - Pros: Better performance of low-complexity energy detection Rx, efficient duty cycling.
  - Cons: Precise localization needs correlator and exact knowledge of transmitted pulse shape, higher Tx complexity.

IR-UWB Signaling strategies (cont'd.)

We choose several short-pulse chips per symbol signaling strategy for:

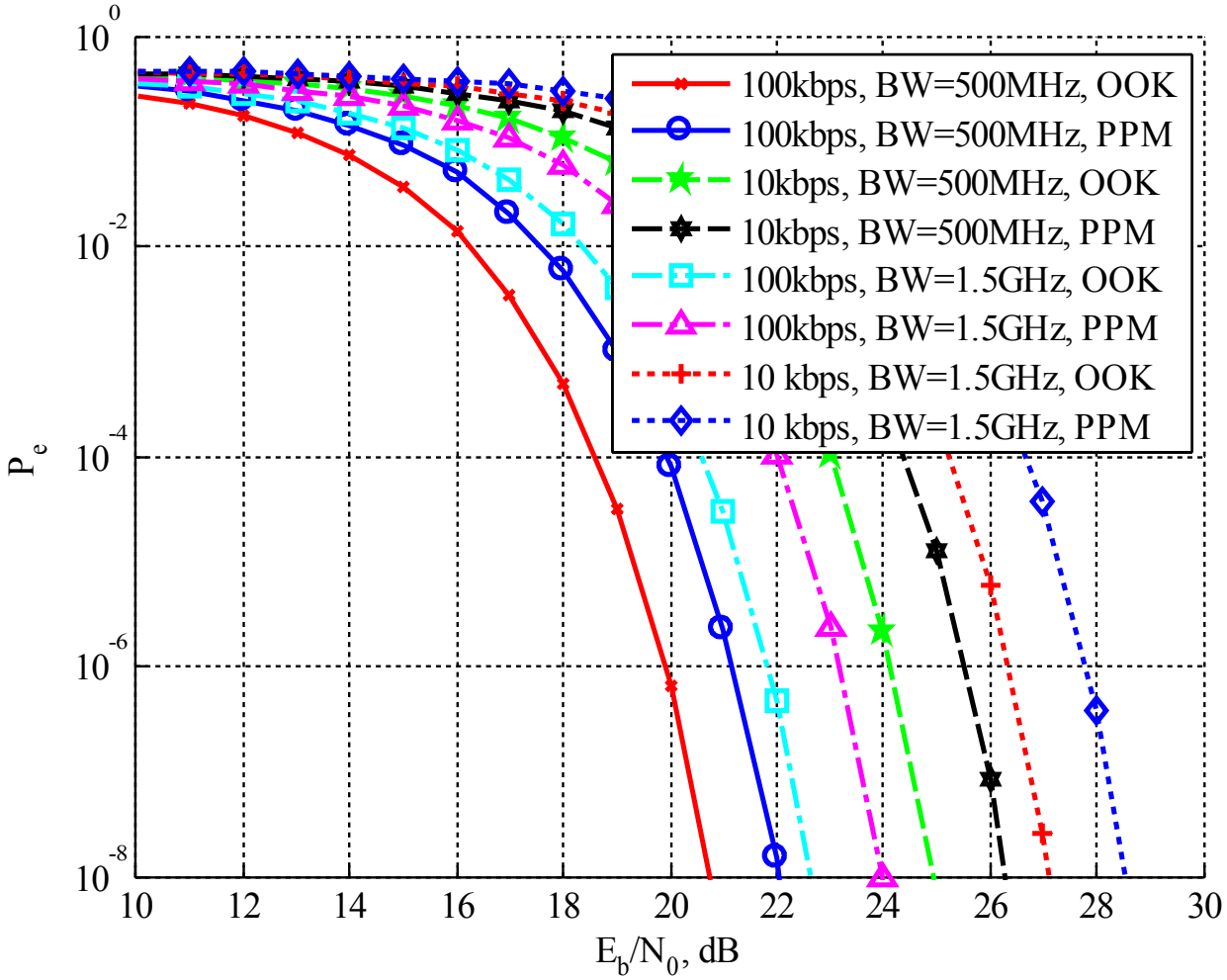
- Precise localization without need of correlator.
- Loose Tx pulse specs needed.

Modulation/detection schemes considered

Having in mind low-complexity energy as well as coherent receivers, two modulation schemes are considered:

- Binary Pulse Position Modulation (PPM)
- Binary On-Off Keying (OOK)

PPM vs OOK


100kbps, BW=500MHz, OOK
100kbps, BW=500MHz, PPM
10kbps, BW=500MHz, OOK
10kbps, BW=500MHz, PPM
100kbps, BW=1.5GHz, OOK
100kbps, BW=1.5GHz, PPM
10 kbps, BW=1.5GHz, OOK
10 kbps, BW=1.5GHz, PPM
P_e
10^{0}
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10
12
14
16
18
20
22
24
26
28
30
E_b/N_0, dB

PPM vs OOK (cont'd)

- Performance of both PPM and OOK deteriorates with increase of signal dimension, i.e. decrease of data rate and increase of bandwidth.
- OOK has better performance in all cases considered.
- OOK detection consumes less power in Rx.

Conclusions

- We analyzed signaling strategies and modulation schemes for low data rate IR-UWB PHY.
- Between classic IR-UWB signaling with short-pulse chips per symbol and transmitting one continuous waveform per symbol we choose classic IR-UWB signaling.
- Between 2PPM and OOK modulations we choose OOK.