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

Submission Title: [NICT Impulse Radio Ultra Wideband PHY Pre-proposal to IEEE 802.15.8 group for PAC]
Date Submitted: [May 2013]
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Re: [TG8 Call for Proposals (CFP) (DCN:13-0069-05-0008)]

Abstract: [The document provides an overview of forthcoming NICT proposal for Impulse Radio Ultra Wideband (IR-UWB) PHY for 15.8 group for Peer Aware Communications]

Purpose: [To inform 15.8 group about the benefits of IR-UWB PHY]

NICT Impulse Radio Ultra Wideband PHY Pre-proposal to IEEE 802.15.8

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Motivation

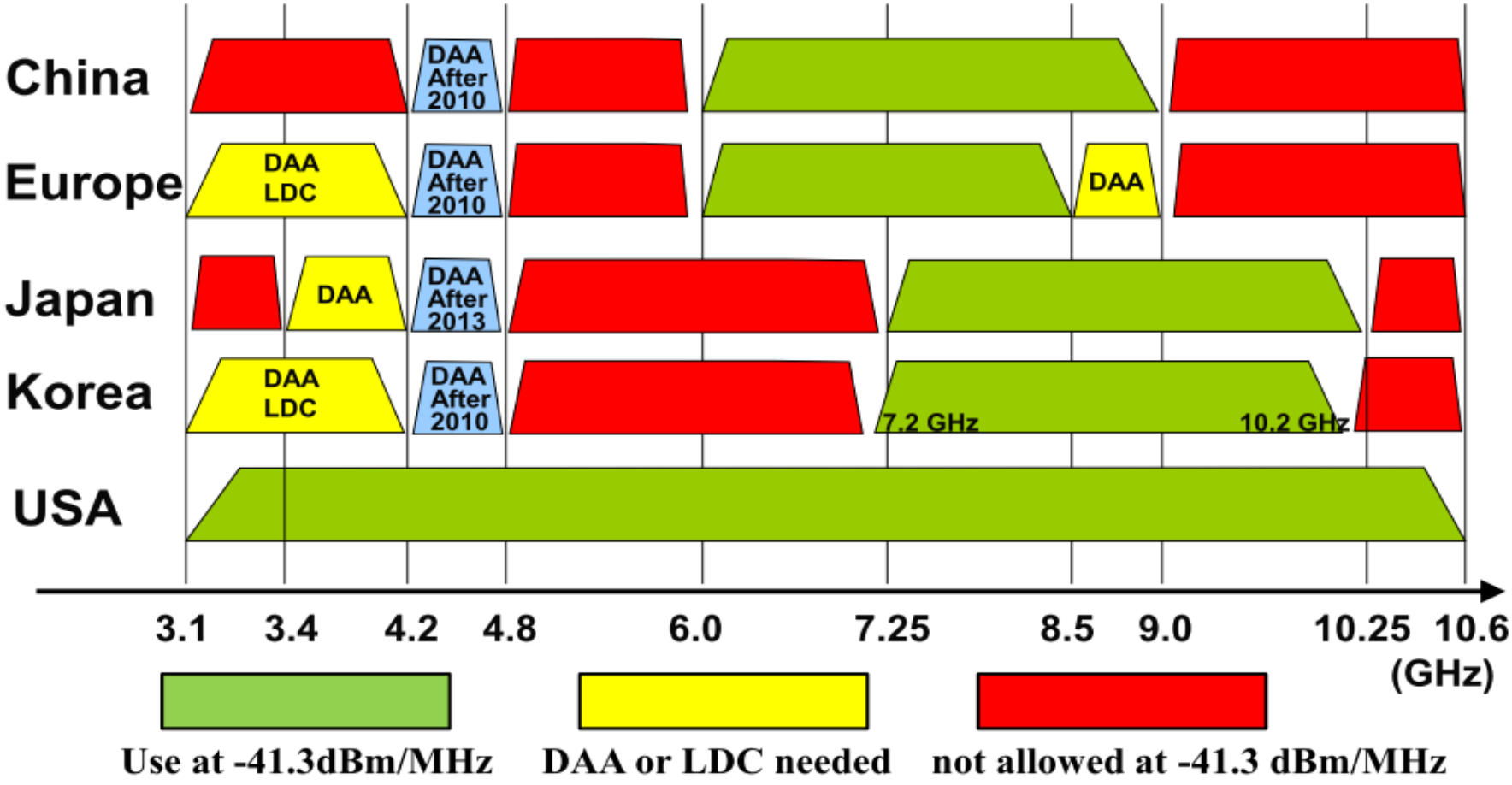
Advantages:

- UWB band is regulated worldwide.
- Power consumption of IR-UWB devices is low.
- Due to large bandwidth precise localization is possible.

Downside:

- Low regulated Power Spectral Density (PSD) levels of -41.3 dBm/MHz allow low Tx power.

UWB Regulations Worldwide



Channelization

- Maximum allowed PSD level is low.
  - The main limitation of the system is low Tx power.
- We are proposing a single channel for the system to maximize allowed Tx power level.
- Channel location and bandwidth are determined by regulation at a given Geo.

Pulse shape and duration

- We do not define a specific pulse shape.
  - Allow different low-complexity pulse generators.
  - Pulse bands will be different at different Geos.
- Pulse shape will be constrained
  - In spectrum by the local regulations.
  - In duration by the Duty Cycle (DC) of no more than DC=1/32=3.1%.

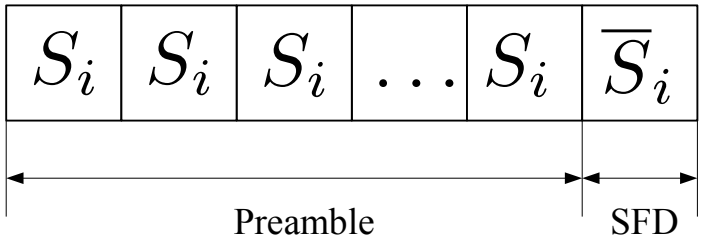
Packet structure

SHR – Synchronization Header

PHR – PHY Header

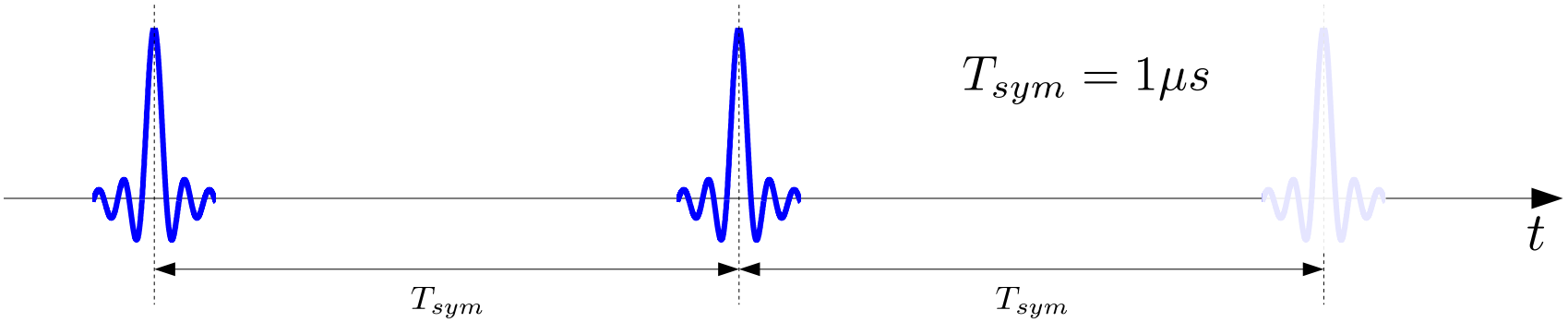
PPDU – Physical Layer Protocol Data Unit

SHR Structure



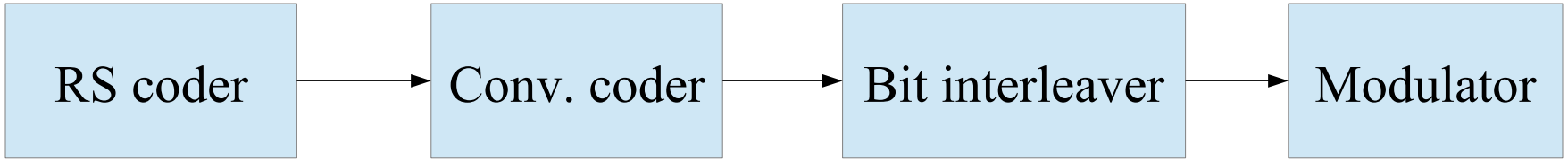
- Preamble consists of *M* times repetition of the sequence S_i.
  - *M* will be determined through simulations.
- S_i is one of the Gold sequences of length 31.
  - Relatively short length with good circular autocorrelation properties.
- Sync. Frame Delimiter (SFD) represents inversion of S_i used in the preamble.

Symbol structure



- On-Off Keying (OOK) modulation is used.
- The same symbol structure will be used in all parts of the packet (SHR, PHR, PSDU).
- We will consider if to use time hopping (TH) or not based on multiple access interference performances with and without TH.

Channel coding and data rates



- Coding is concatenation of outer Reed-Solomon $RS_6(63,55)$ codes and inner convolutional codes.
- Highest data rate is obtained without any convolutional coding.
- Lower data rates are achieved through convolutional coding rate.

Conv. Coding rate	1/16	1/8	1/4	1/2	1/1
Data rate (kbps)	54.56	109.12	218.25	436.51	873.02

Conclusions

- IR-UWB PHY features
  - Low complexity
  - Low Tx power
  - Low data rate
  - Low power consumption
  - Low to medium range
  - High localization accuracy