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

Submission Title: UWB for data streaming use cases – suitable features overview
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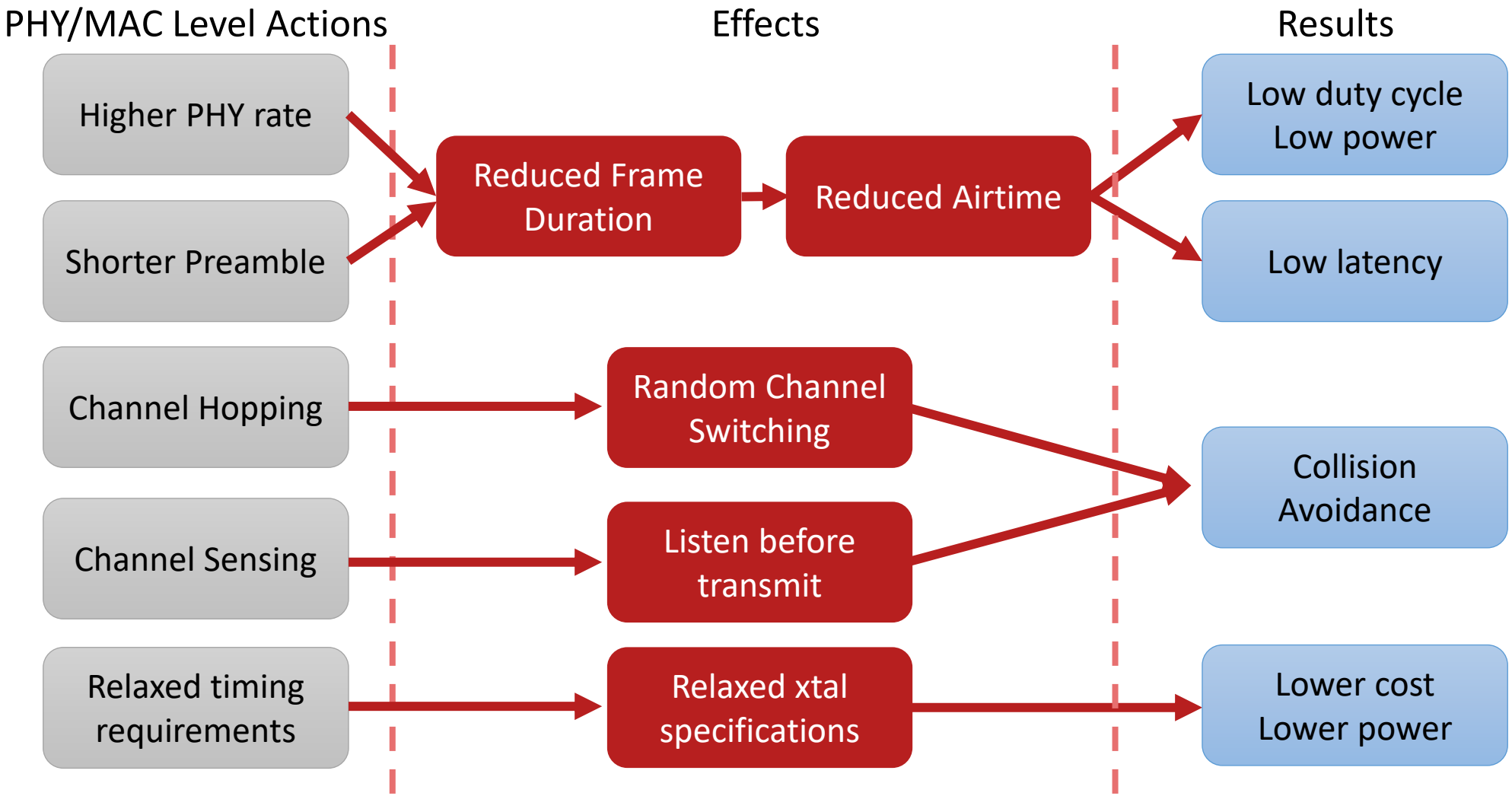
Source: Frederic Nabki (Spark Microsystems)
Address: 1201 rue Barré Suite 201, Montréal QC, Canada
E-Mail: frederic.nabki@sparkmicro.ca

Re: IEEE 802.15 IG NG-UWB Plenary Meeting

Abstract: PHY/MAC layer features for efficient UWB data streaming

Purpose: Discuss low-power & low latency data communications applications

Essential Technical Characteristics



- Non coherent detection obviating the need for RF carrier generation
- Compared to coherent receivers,
  - Fast (sub ms) channel hopping is possible (with the help of fast synthesizer settling time)
  - Fast radio start-up (few ms) is possible
  - Relaxed requirements of the frequency and phase accuracy of the system
- Frequency selective fading compared to flat fading of narrow band radios
- More robust against multipath fading due to lower phase sensitivity compared with coherent detection

- Channel hopping is used to avoid collisions
- Also confers frequency diversity benefits yielding fading or interference robustness advantages
- Flexible output spectrum shaping at the transmitter
- 500 MHz bandwidth channels are used by default, but other bandwidths are also possible

Channel Sensing (1/2)

- Transmitter listens before transmit using Energy Detection
- Used for assessing the background power inside of a single UWB channel
- Aims to get a pass-fail result to maximize TDMA capability on uncoordinated links
- Set a maximum allowable power level in a channel
- Autonomously samples the channel until the power level is adequate or else hop frequency

- Allows for harmonious operation with other uncoordinated UWB systems, including legacy devices
- Can also detect other interferers such as WIFI (without complex preamble detection)
- Provides avoidance via hopping or by transmission between WIFI traffic as UWB frame is in micro-second scale
- Channel Sensing is a part of channel access mechanism
- Allows intelligent link optimization (specially for smaller places where the sensitivity is good)

- High symbol rate of the PHY layer allows to reduce frame air time
  - Better TDMA capabilities (lower duty cycle for a given payload)
  - Higher payload capabilities
- Allows for aggressively low duty cycle of the radio
  - Reduced power consumption and much higher energy efficiency (<5nJ/bit TX+RX)
- Reduced radio latency due to shorter frame time
  - Key capability vs narrowband radios
- Ultra-short preamble (<15 μs) should also be supported to benefit from the reduced frame airtime and enhance the impact of the high PHY rate.
  - Long preamble is not required for data streaming applications

Power Consumption Reduction Opportunities

- Impulse radio is uniquely positioned to attain near-linear scaling of power consumption with data-rate
- Non coherent transmitter and receiver can startup very quickly leading to efficient duty cycling between frames in many cases

	HRP-ERDEV PHY	LRP-ERDEV PHY
Transmit center frequency	+/- 20 ppm	No requirement, as long as fits in spectral mask
Chip rate clock	+/- 20 ppm	+/- 2 ns
Carrier and chip rate clock	Derived from same oscillator	Independent
Detection	Coherent	Non-coherent
Max payload rate	28 Mbps	5 Mbps

- Duality between the two PHYs:
  - Frequency/timing: accurate (HRP) vs. approximate (LRP)
  - Detection: phase coherent (HRP) vs. Energy detection (LRP)
  - Performance: maximum link budget and data rate (HRP) vs. Moderate link budget and data rate (LRP)
  - Relative power consumption: high (HRP) vs. Moderate (LRP)

- There is merit in HRP-like data rates with LRP-like implementation cost