

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

**Submission Title:** UWB for data streaming use cases

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**Re:** IEEE 802.15 IG NG-UWB Plenary Meeting

**Abstract:** Technical characteristics of UWB for data streaming

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

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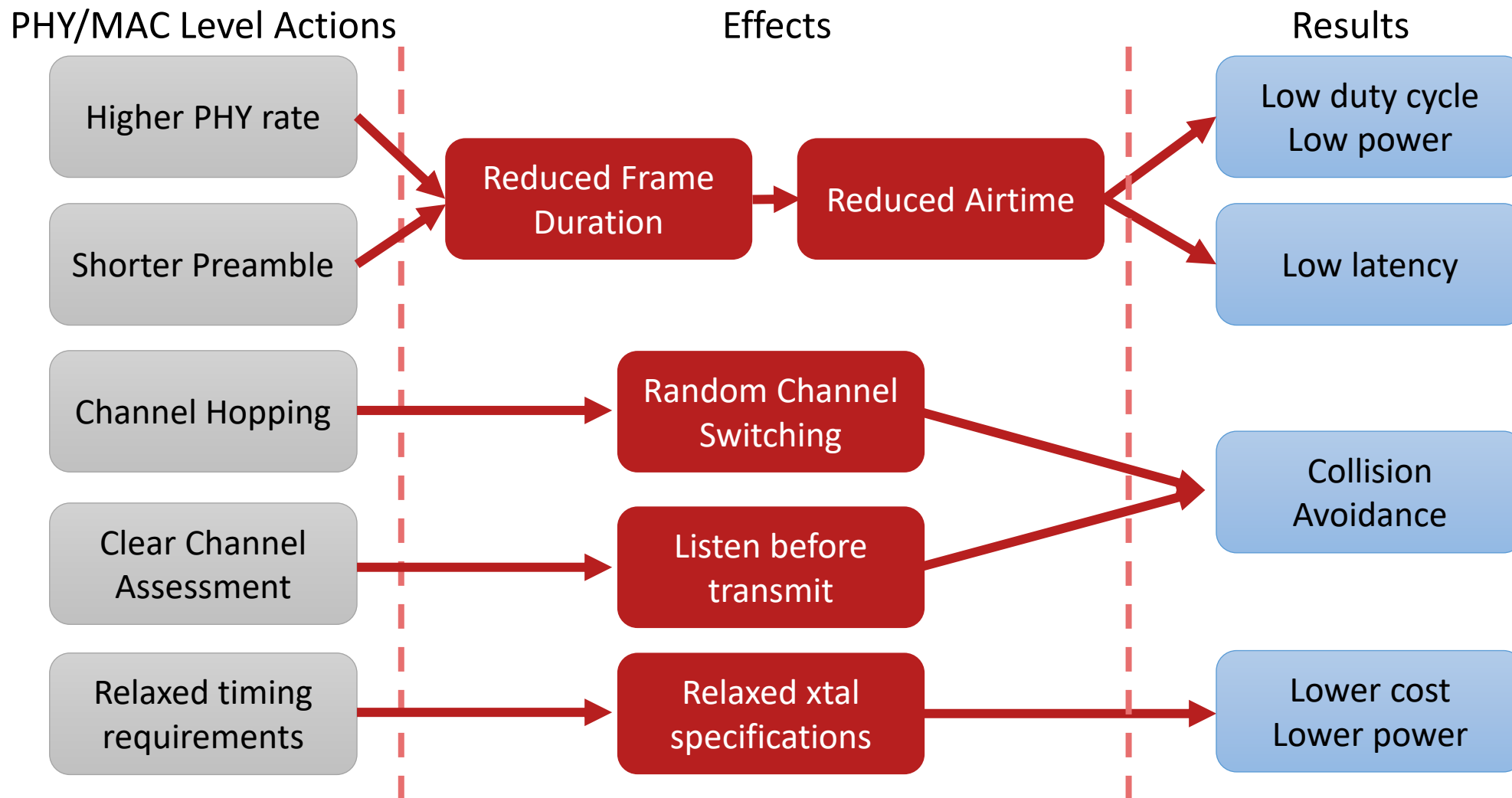
## PAR key points to improve UWB data streaming

- Preamble and modulation schemes to support improved link budget and/or **reduced air-time**
  - Interference mitigation techniques to **support higher density and higher traffic use cases**
  - Schemes to **reduce complexity and power consumption**
  - Mechanisms supporting **low-power low-latency streaming** as well as **high data-rate streaming**
  - Support for **peer-to-peer, peer-to-multi-peer, and station-to-infrastructure** protocols are in scope
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- Keeping in mind **low-cost** of implementation

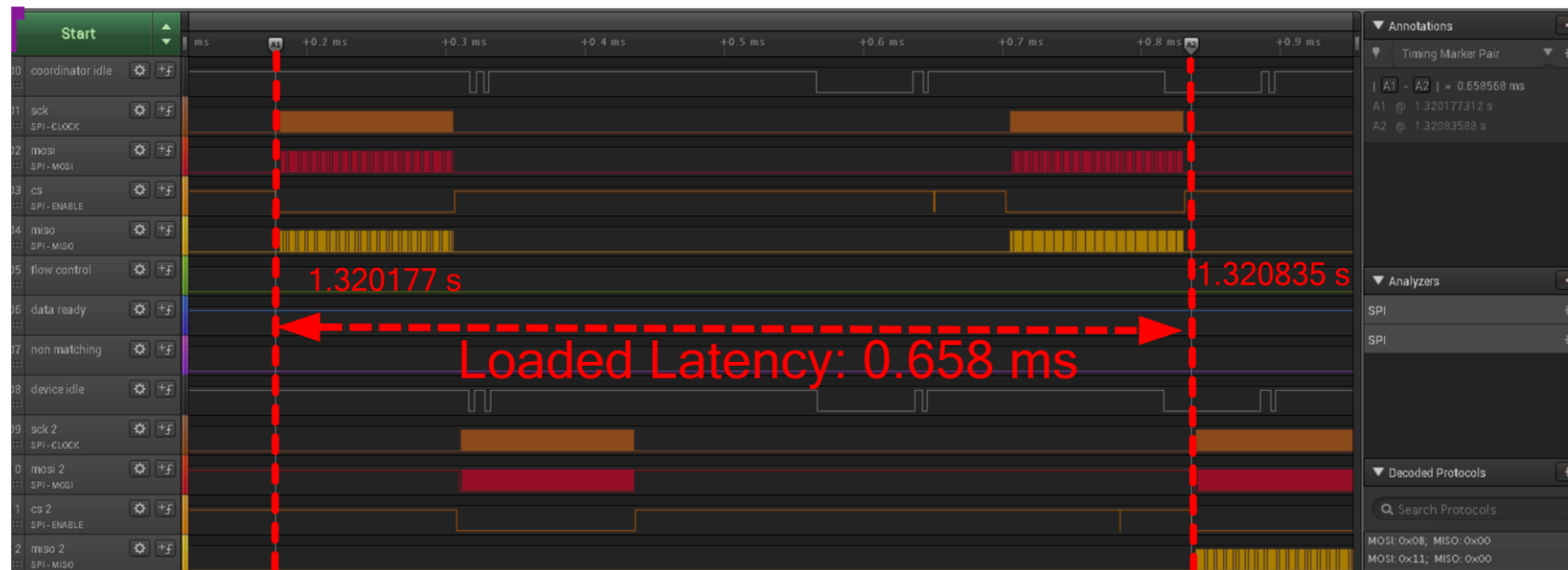
# Essential Technical Characteristics

doc.: <15-21-0171-00-nuwb>

Class of Devices	Application / Use cases	Link budget requirement	Payloads requirement	Current consumption. (in active state)	Technical Characteristics
Data streaming	<b>Audio Real time / low latency streaming</b> - Headphones, hearables, audio devices	- moderate (PL $\approx$ 80 dB, d $\approx$ 30 m) - proximity (PL $\approx$ 60 dB, d $\approx$ 3m)	Continuous payload, moderate duty cycles (e.g. 1.5-5 Mbps payload at low latency) with clear channel assessment mitigation	up to 3 mA	<ul style="list-style-type: none"> <li>• 3 ms audio latency</li> <li>• 0.25 nJ/bit TX energy efficiency</li> <li>• 1.15 nJ/bit RX energy efficiency</li> <li>• Data-rate up to 96 KSps, 24 bit, Stereo</li> <li>• Possible dual transceiver</li> </ul>
	<b>Audio/Video real time / low latency streaming</b> - AR with multi-channel a/v (Gaming)	- moderate (PL $\approx$ 80 dB, d $\approx$ 30 m) - proximity (PL $\approx$ 60 dB, d $\approx$ 3m)	Continuous payload, moderate duty cycles (e.g. 4-10 Mbps payload at low latency) with clear channel assessment mitigation	up to 5 mA	<ul style="list-style-type: none"> <li>• 5-10 ms audio latency</li> <li>• 10 ms video latency</li> <li>• Possible dual transceiver</li> </ul>
	<b>Network of objects</b> - Sensors network ( Medical , Transport, Agriculture...) - BAN (Medical, Vital signs monitoring) - PAN (Wireless peripherals, Home office)	- moderate (PL $\approx$ 80 dB, d $\approx$ 30 m) - proximity (PL $\approx$ 60 dB, d $\approx$ 3m)	Short payloads Low duty cycles (e.g. 1-5 Mbps payload at low latency)	<ul style="list-style-type: none"> <li>• Sub 100 <math>\mu</math>A Sensors</li> <li>• Up to 1.5 mA peripherals</li> </ul>	<ul style="list-style-type: none"> <li>• 50 <math>\mu</math>s airtime for 1 kb</li> <li>• <math>\sim</math>20 <math>\mu</math>W system power consumption for Battery-less IoT sensors</li> </ul>

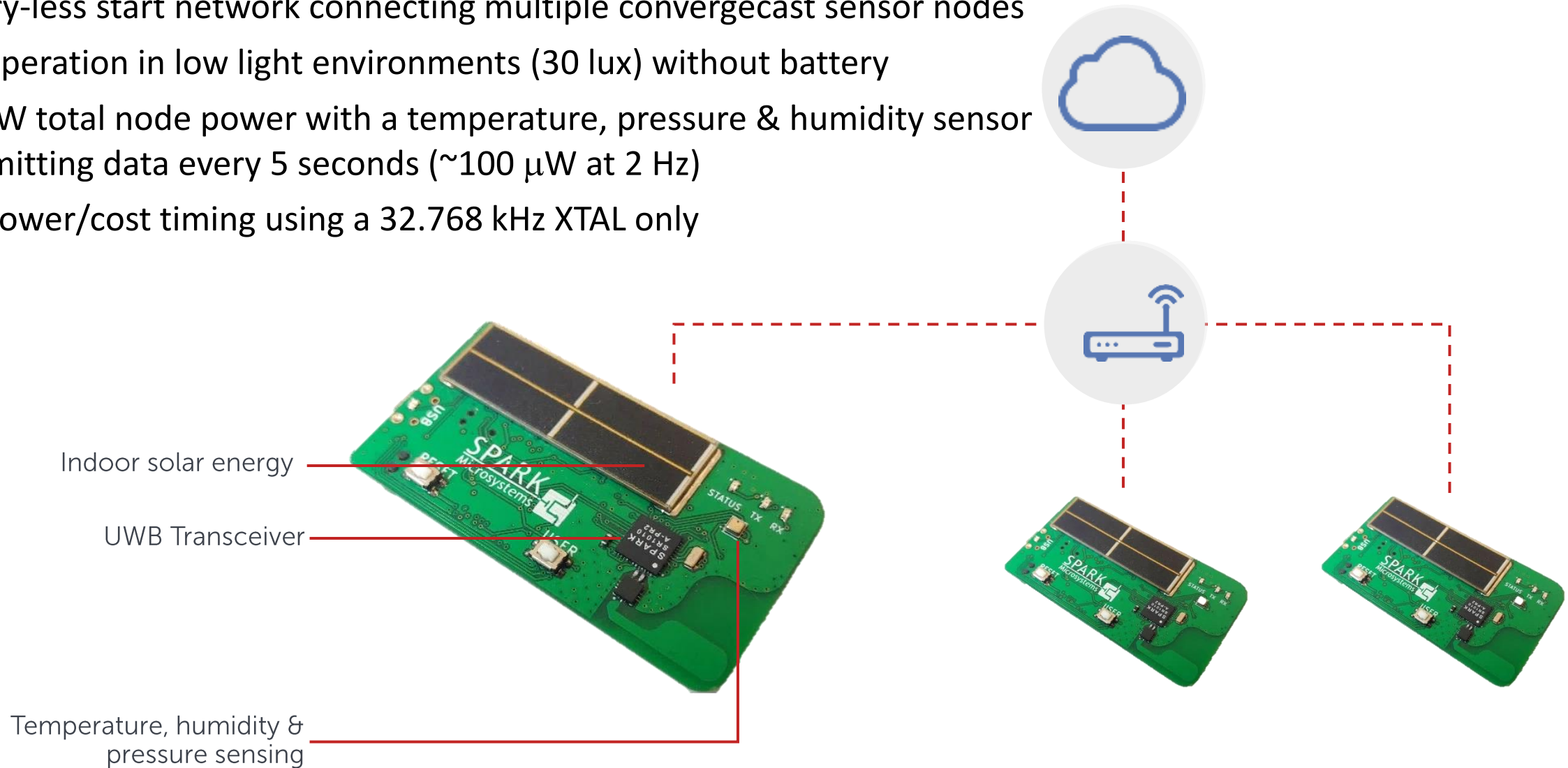


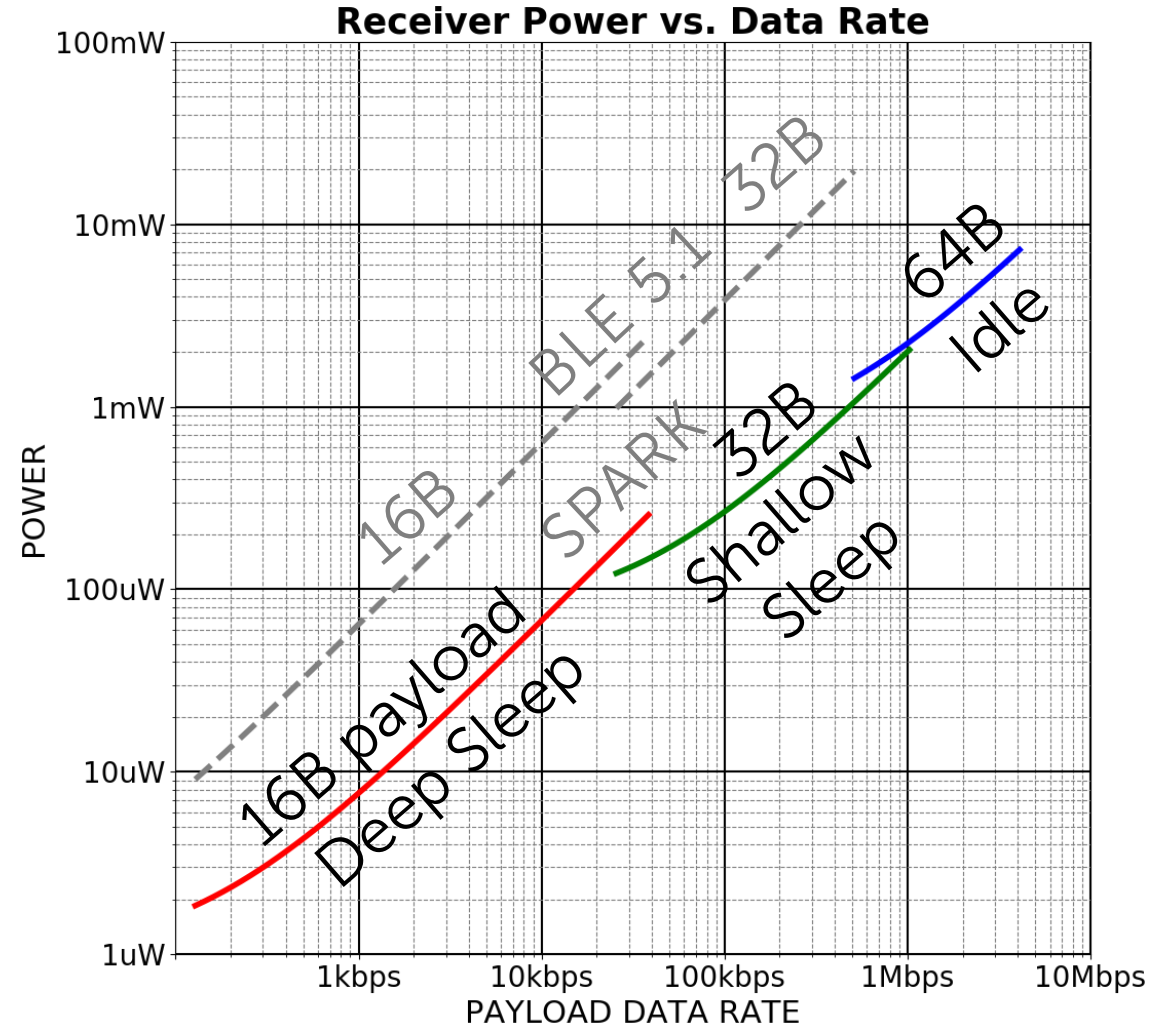
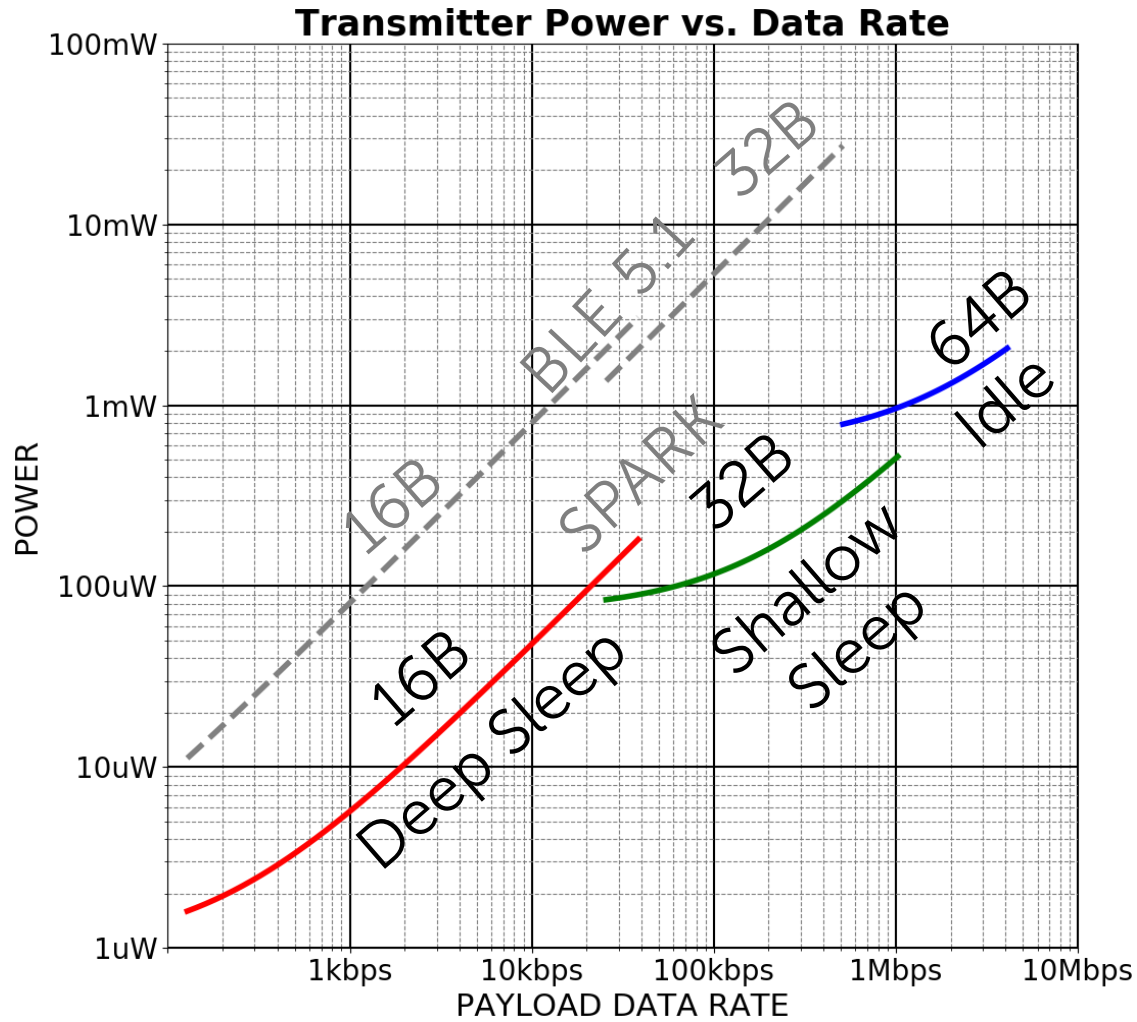
- 3 Mbps half duplex payload UWB link with ARQ via SPI interface (wireless SPI)
- Payload airtime: 90  $\mu$ s
- Timeslot duration: 250  $\mu$ s
- Power consumption TX+RX: 9 mW at 3.3V (1.5 Mbps uplink + 1.5 Mbps downlink)
- Loaded latency from SPI to SPI: 0.658 ms
- Low power/cost timing using a 32.768 kHz XTAL only



# Battery-less IoT Sensor Node Example

- Battery-less start network connecting multiple convergecast sensor nodes
  - Operation in low light environments (30 lux) without battery
- ~20  $\mu\text{W}$  total node power with a temperature, pressure & humidity sensor transmitting data every 5 seconds (~100  $\mu\text{W}$  at 2 Hz)
- Low power/cost timing using a 32.768 kHz XTAL only





	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)
  - Power consumption: high (HRP) vs. Moderate (LRP)
  
- There is merit in HRP-like data rates with LRP-like implementation cost