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

Submission Title: [Low cost ,Low power design prototype for ULP]
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Re: [In response to TG4q Call for proposals]
Abstract: [This contribution proposes ULP Low cost and Low power design.]

Low cost ,Low power design prototype for ULP

January 6, 2014

Congcong Zhou, ZJU

Abstract

- **This presentation demonstrate three Low cost ,Low power design prototypes for ULP.**

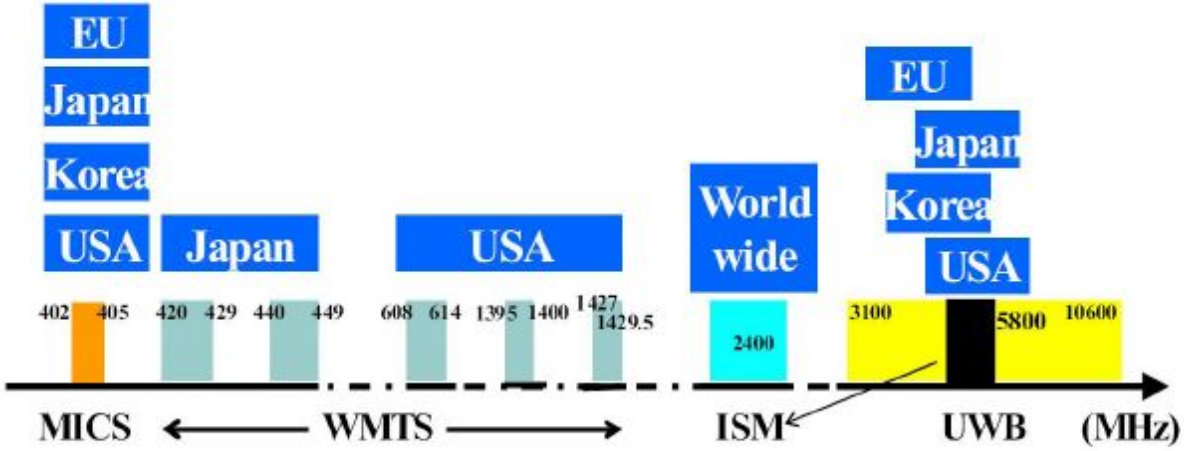
Review of TG4q PHY bands and Data rates

PHY(MHz)	Frequency band(MHz)	Spreading parameters		Data parameters		
		Chip rate (k chip/s)	Modulation	Bit rate (kb/s)	Symbol rate (k symbol/s)	Symbols
868/915	868-868.6	300	BPSK	20	20	Binary
	902-928	600	BPSK	40	40	Binary
2450	2400-2483.5	2000	Q-QPSK	250	62.5	16-ary Orthogonal

The standard offers two PHY options based on the frequency band. Both are based on direct sequence spread spectrum (DSSS). The data rate is 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz. The higher data rate at 2.4GHz is attributed to a higher-order modulation scheme.

Lower frequency provide longer range due to lower propagation losses. Low rate can be translated into better sensitivity and larger coverage area. Higher rate means higher throughput,lower latency or lower duty cycle.[1]

Review of Frequency bands for WBAN

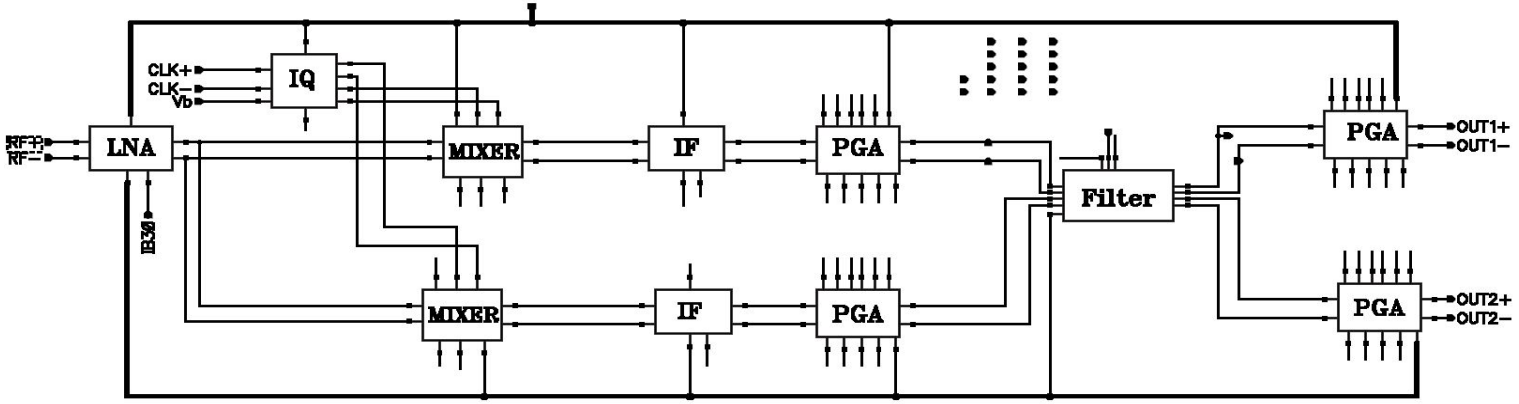


Frequency bands for WBAN [2]

A short summary of some of the frequency bands available for WBAN in different countries[2]. Medical Implant Communications Service (MICS) band is a licensed band used for implant communication and has the same frequency range (402-405 MHz) in most of the countries.

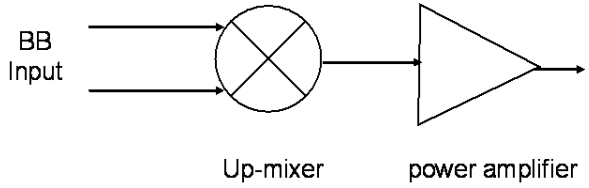
Low cost ,Low power design prototype 1

- A 900-930MHz Tranceiver Design.



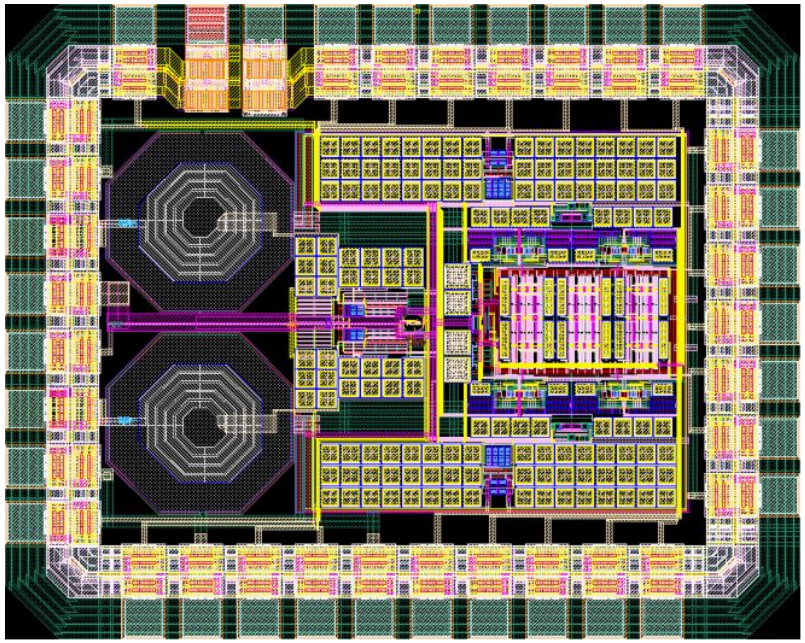
Receiver block diagram

- Low cost Processing Technic
  - 0.18um CMOS Technic
- Low power realization
  - 250Kbps datarate
  - 1.8 V Power supply
  - 21mA Current comsumption

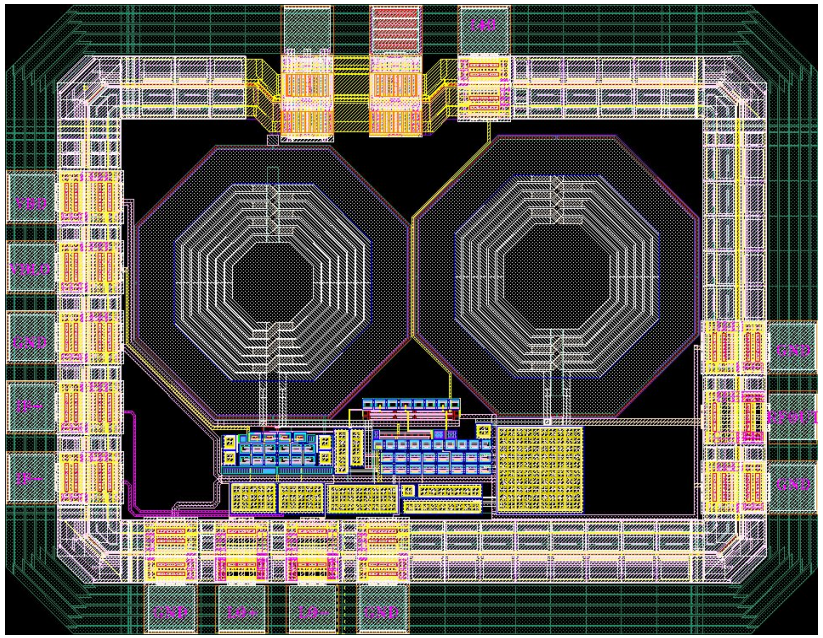


Transmitter block diagram

Low cost ,Low power design prototype 1



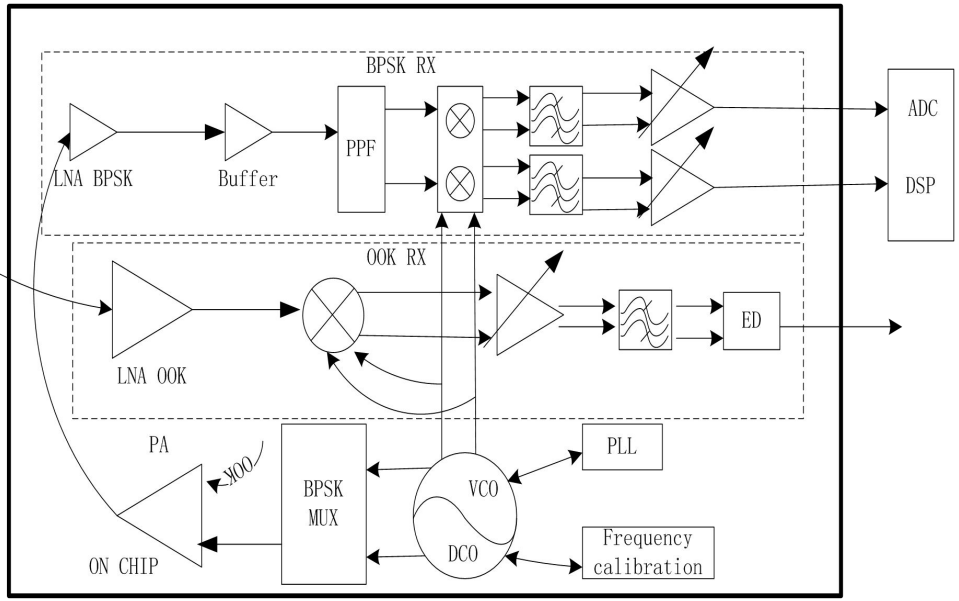
The Receiver



The Transmitter

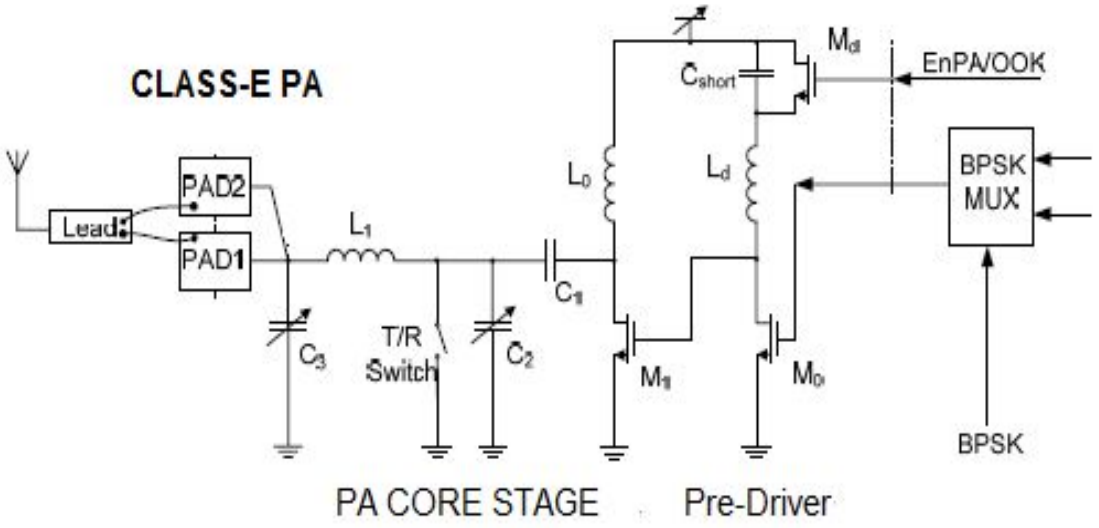
Low cost ,Low power design prototype 2

- **A 2.4GHz Tranceiver Design.**
  - **Low cost Processing Technic**
    - **0.13um CMOS Technic**
    - **Chip area of 3.3 mm2**
  - **Low power realization**
    - **250Kbps datarate**
    - **BPSK transmitter consumes only 3.66 mW at 0.2 dBm output power.**
    - **The BPSK receiver achieves sensitivity of -84.5 dBm at 5 Mbps data-rate.**



The system diagram of the proposed tranceiver

Low cost ,Low power design prototype 2



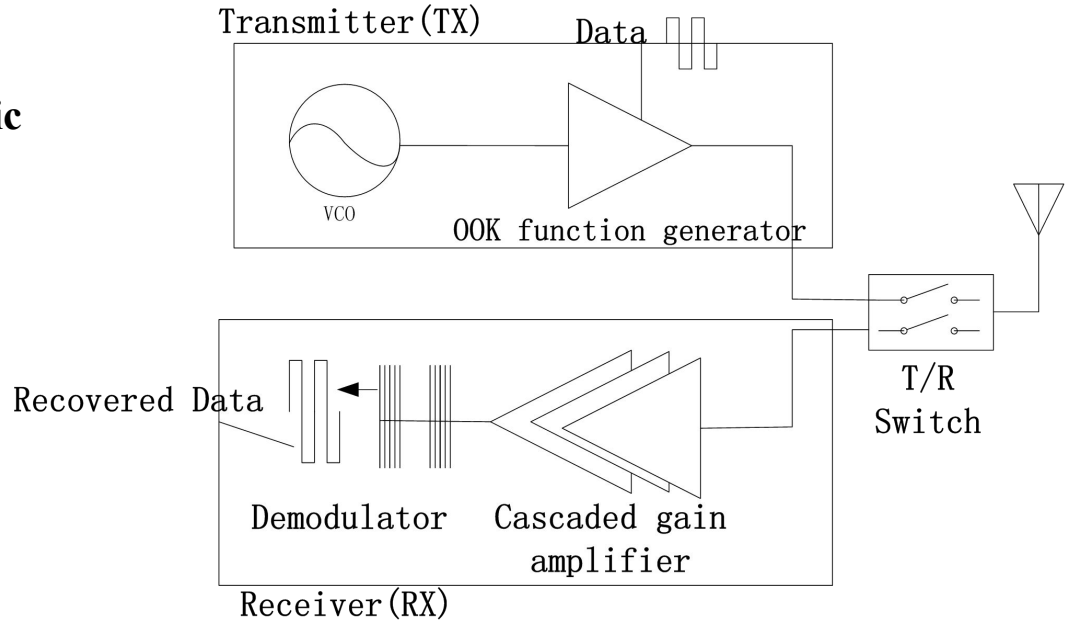
The transemit circuit

The TX of the transceiver is composed of the PA and the BPSK modulation MUX.

Low cost ,Low power design prototype 3

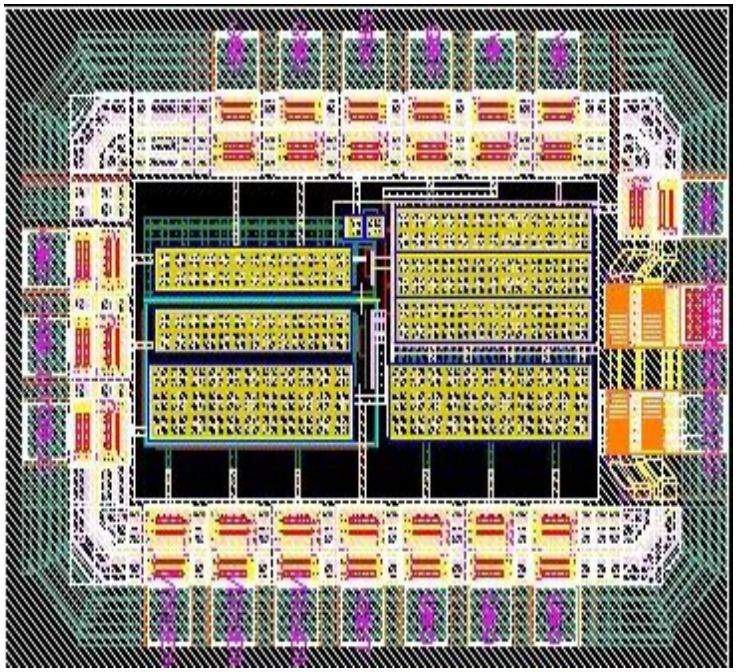
- **A 400MHz Tranceiver Design.**

- **Low cost Processing Technic**
  - **0.18um CMOS Technic**
- **Low power realization**
  - **0.25mW**
  - **1.8 V Power supply**

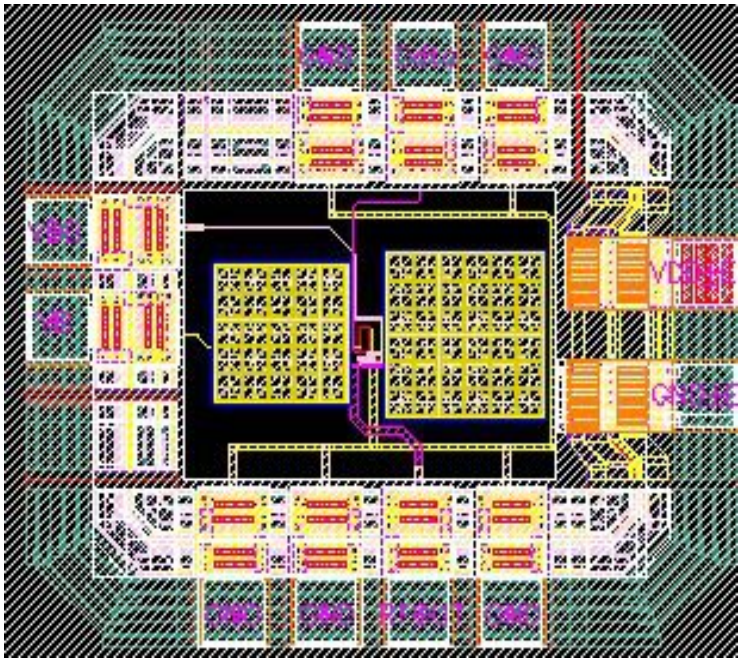


System block diagram

Low cost ,Low power design prototype 3



The Receiver



The Transmitter

Conclusion

- **TG4q PHY bands and Data rates is reviewed as the guide line.**
- **Frequency bands for WBAN is reviewed as additional reference.**
- **Three Low cost ,Low power design prototypes for ULP is demonstrate.**

Refence

- [1] SC Ergen"ZigBee/IEEE 802.15.4 Summary"September 10, 2004
- [2]A. W. ASTRIN, H.-B. LI, and R. KOHNO, "standardization forbody area networks, IEICE Transactions on Communications", vol. E92.B, no. 2, pp.366.372, 2009.
- [3] Li-Chen Liu, Ming-Han Ho "A Medradio-Band Low Energy-Per-Bit CMOS OOK Transceiver for Implantable Medical Devices" Biomedical Circuits and Systems Conference (BioCAS), 2011, IEEE
- [4] Jun Tan, Wen-Sin Liew, Chun-Huat Heng, and Yong Lian, "A 2.4 GHz ULP Reconfigurable Asymmetric Transceiver for Single-Chip Wireless Neural Recording IC," to appear in *IEEE Trans. on Biomedical Circuits and Systems*