



MoteScatter

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Abstract

A lot researches focus on how to design a energy-efficient Radio Duty Cycle(RDC) mechanism in Medium Access Control(MAC) Layer. However, in this demo, we find that the reflected wireless signal could be modulated with starting the oscillator of the RF transceiver equipped in Tmote-Sky. Based on this principle, we propose MoteScatter, in which Tmote-Sky can generate ASK waveform with backscattering 2.4GHz wireless signal and send message.

My Work

-In this demo, our work contains two aspects. First, we analyze the impact on the reflected signal with different operation of CC2420, the RF transceiver on Tmote-Sky to find an appropriate way to reflect the 2.4 GHz incident signal. Secondly, we implement MoteScatter to send message and the reflected waveform is received and demodulated with USRP.

Prototype

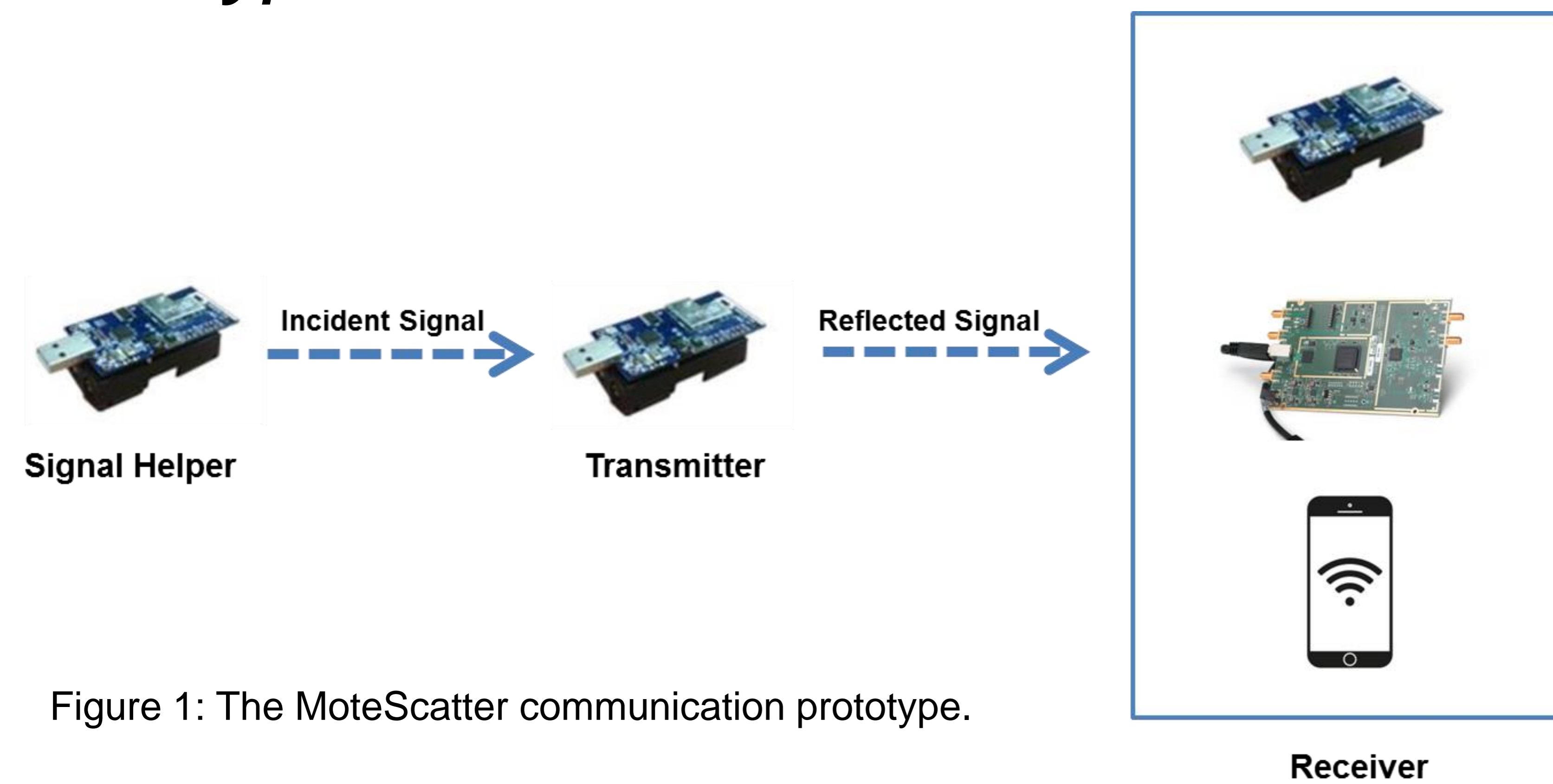


Figure 1: The MoteScatter communication prototype.

Transmitter

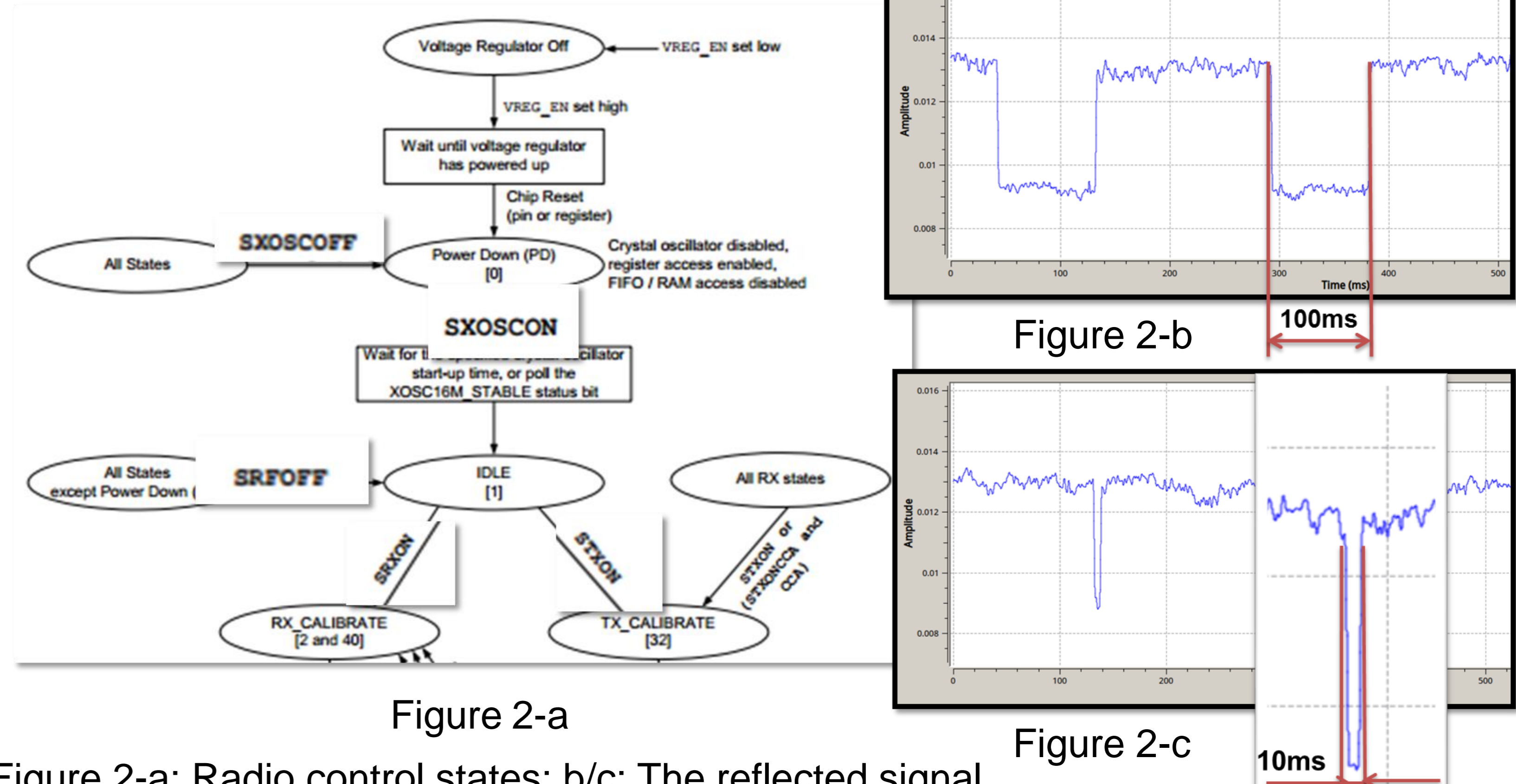


Figure 2-a: Radio control states; b/c: The reflected signal.

- **Backscatter Communication:** The switch of a transmitter toggles its antenna's load to different impedances. As a result, the RF signals reflected by the antenna have different amplitudes, which are used to transmit information.
- Shown as Figure 1, One Tmote-sky generates the **Incident Signal** (ZigBee single tone) as **Signal Helper**; another Tmote-sky **reflects RF signal** for communication by changing the impedance of Tmote as **Transmitter**; we plan to use Tmote-sky, SDR and other Wi-Fi devices to receive the reflected signal. Now we achieved the USRP as the **Receiver**.

- As shown Figure 2-a, we change the impedance of the Tmote by controlling the register.
- When the Tmote-sky's impedance is changed, it has a very short pulse, shown as the Figure 2-b/c, and the slot is 100ms or 10ms.
- But when the Tmote is directly switched on/off, the state is almost static, and we can control the pulse slot width.
- Result: Only **strobe (SXOSCON)** can make a pulse, shown as Figure 2-c, but the system default wait 100ms, so the rate is limited to 8-10bps.

Receiver

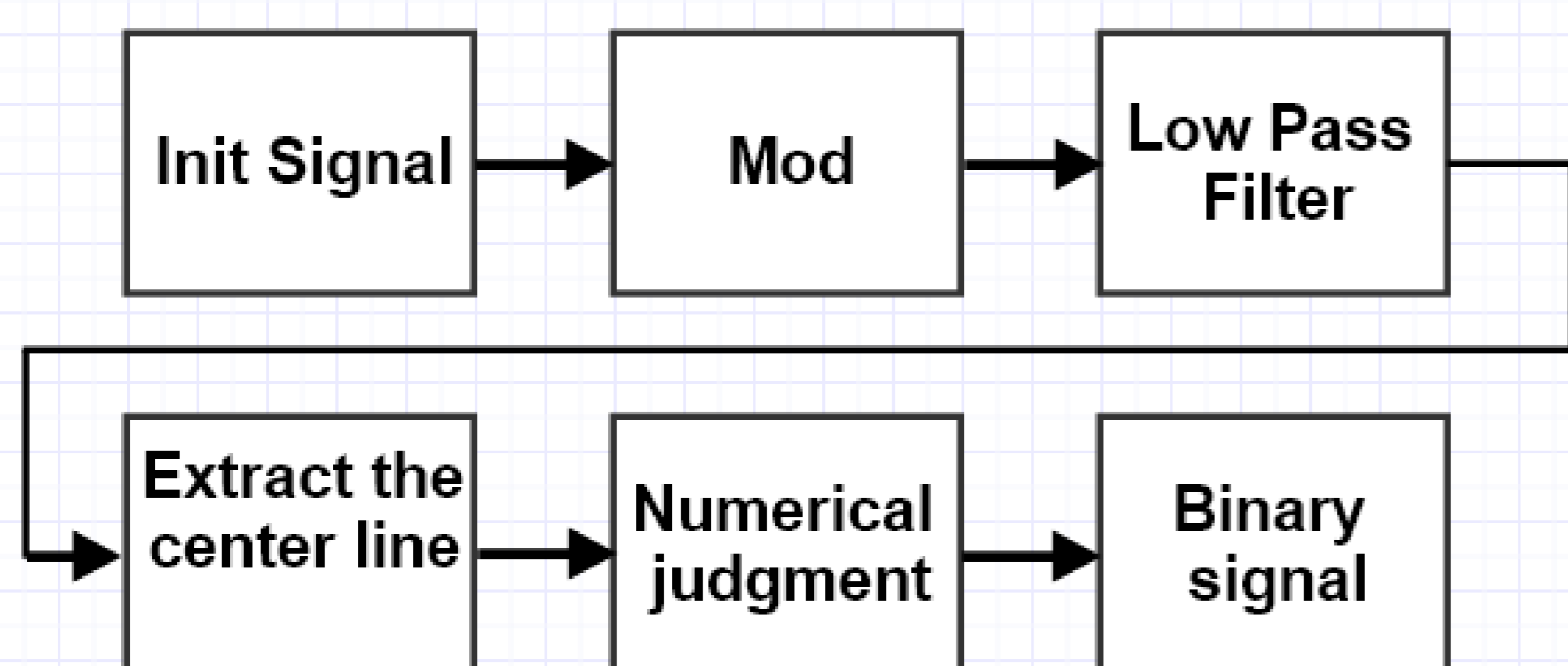


Figure 3: The design of receiver(usrp_b200)..

Receive the reflected signal by USRP_b200, and demoded the signal to 0/1.

Implementation & Results

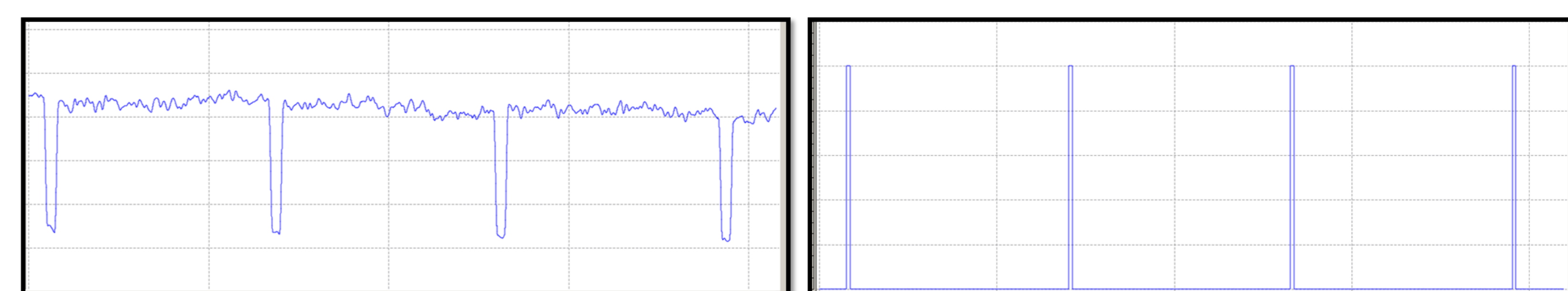


Figure 4: The receive signal..

We implement the system with two Tmote-skys and one USRP_b200, and evaluate the communication ability of MoteScatter, It can achieve ultra low-power communication and transmit as far as about 1 meter with 8-10 bits/s.