Enhancement of backscatter tags efficiency by means of low-power transistor-based reflection amplifier and QPSK modulator

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In this presentation, we propose a low power consumption reflection amplifier integrated with a phase shifter to be used in the backscatterer tags. In backscattered communication, the reader emits a carrier signal that is reflected back by a tag. The tag modulates this reflection which can be demodulated by the reader for information extraction.

Backscatter communication is challenged by restrictions on the coverage range due to the limited intensity of the power reflected by the tags and by the sensitivity of the reader. Hence, to increase the coverage range, either higher power intensity of the reflected signal is needed or the sensitivity of the reader should be increased, or both. Recent works have use an active circuit called reflection amplifier to increase the coverage range. A reflection amplifier is a one-port active device. Its negative input resistance makes the magnitude of input reflection coefficient larger than unity, $|\Gamma_{in}| > 1$, thus amplifying the reflected wave.

However most of these system use On-Off Keying (OOK) modulation for the reflected wave by simply turning the reflection amplifier on and off.

The reflection amplifier is designed in the 2.4 GHz frequency band using Heterojunction Ga-As FET common source transistor with the reflection gain of 15 dB. Transistors can show negative resistance if they are designed for a specific feedback configuration, which is also considered as oscillators.

The reflection amplifier is then integrated with a digital phase shifter to apply Quadrature Phase Shift Key (QPSK) modulation on the reflected wave. The digital phase shifter injects four quadrature phases on the reflected signal. In the propose tag circuit, the QPSK modulated and amplified reflected wave covers higher distance between the reader and the tag nodes and also doubles the number of bit per symbol compared with OOK modulation.

It should be noticed that the proposed structure can also be used with higher data rate (NPSK, N>4) communication by increasing the constellation points.