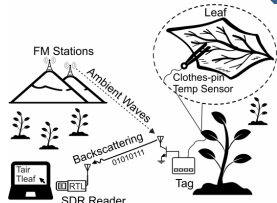


Enhanced FSK-modulated Ambient Backscatter Communication System

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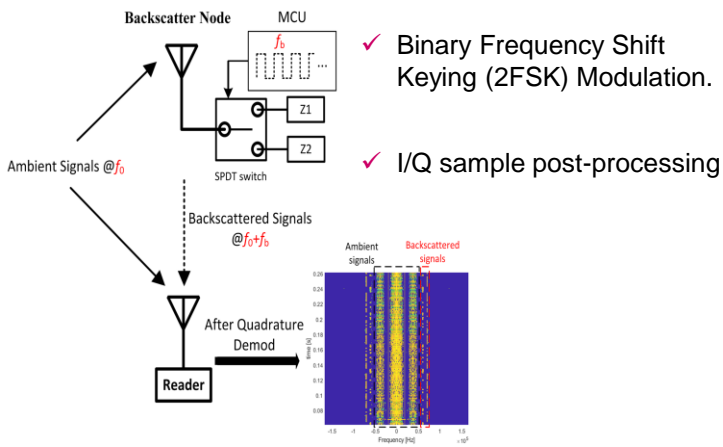
Ultra-low-power Ambient Backscatter Communication

STATUS QUO



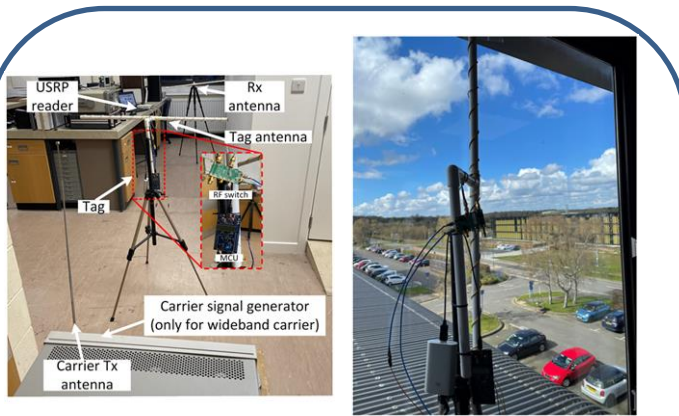
- ✓ Ambient backscatter:
 - Low Power Consumption
 - Maintenance-free
 - Cheap
- ✓ Short communication distance

NEW INSIGHTS



- ✓ Binary Frequency Shift Keying (2FSK) Modulation.
- ✓ I/Q sample post-processing

DESCRIPTION



The System is mainly composed of three parts:

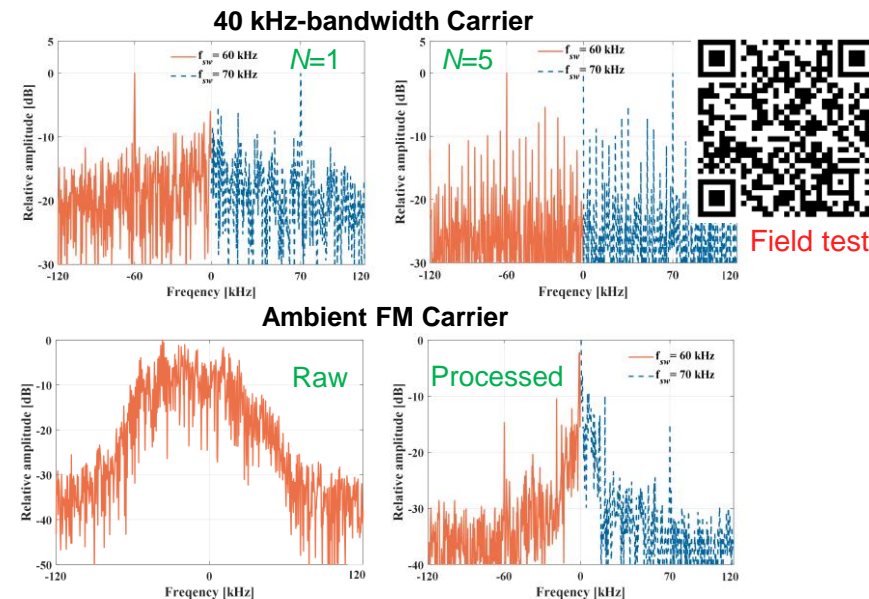
- ✓ **Transmitter (carrier)**
 - Ambient FM Station: 34 KM away
 - Signal generator: single or multiple 40 kHz–bandwidth carrier (N subcarriers, 20kHz spacing)
- ✓ **Backscatter Tag**
 - Dipole antenna
 - SPDT RF switches: ADG918
 - MCU: Low-power STM8L152
- ✓ **Receiver**
 - Software Defined Radio (SDR): USRP-N200
 - MATLAB: I/Q sample processing (Quadrature Demod) and real-time demodulation

$$R(t) = \frac{j2\pi f_b(\tau)}{1+Q \cdot e^{-j2\pi f_b(\tau)t}} + \frac{j \sum_{i=1}^{\infty} 2\pi f_i P_i e^{j2\pi [f_i + f_b(\tau)]t} + jQ \sum_{i=1}^{\infty} 2\pi f_i P_i e^{j2\pi f_i t}}{(1+Q \cdot e^{-j2\pi f_b(\tau)t}) \sum_{i=1}^{\infty} P_i e^{j2\pi [f_i + f_b(\tau)]t}}$$

Desired Backscatter signal

Interference

RESULTING SPECTRUM



ACHIEVEMENT

- ✓ FSK Modulation + IQ sample processing: Apply to Ambient FM and wideband-multicarrier carrier signals
- ✓ Ambient FM backscatter:
 - ❖ Distance: Up to 107meters
 - ❖ Bit rate: 200~333 bps
 - ❖ Tag Power consumption: 1.4mW (MCU)

