# Cheap, Robust, and Secure Wireless Sensing and Logistics: a Feasiblity Study

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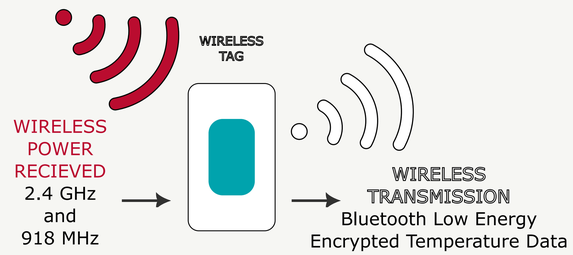



Figure 1. Example of Wireless Tag which collects wireless energy and transmits Bluetooth Low Energy temperature sensor data.

Figure 2. Wireless Bridges (Duel Band, Left and Single Band, Right)


Figure 3. Software Defined Radio (SDR) USRP B200mini

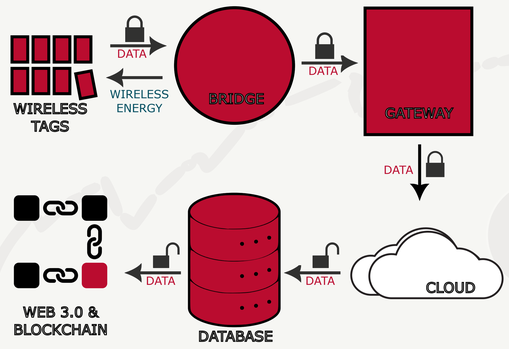



Figure 4. Example of a Three Tier Setup (with Tag, Bridge, Gateway). The gateway then sends the data to the cloud for decryption. The data can then be stored for study and distributed.

## Explore

- Addressing the need for IoT devices which can harvest power from ambient signals and transmit active signals for communication.
- Use IoT tags to wirelessly transmit encrypted sensor information to secure data, increasing trust throughout a physical and digital chain of custody.
- Enable secure and open access to the information and data collected for further agricultural food study research.

## Establish

- Using cutting edge wireless IoT tagging technology an agricultural product's temperature can be sensed and encrypted.
- This encrypted data is then broadcast via an advertisement packet over Bluetooth LE (Low Energy) to any device listening.
- Because the data transmitted is already encrypted, there can be no tampering with the data at a physical level.

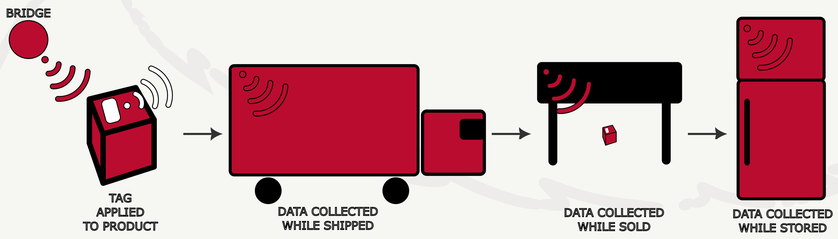
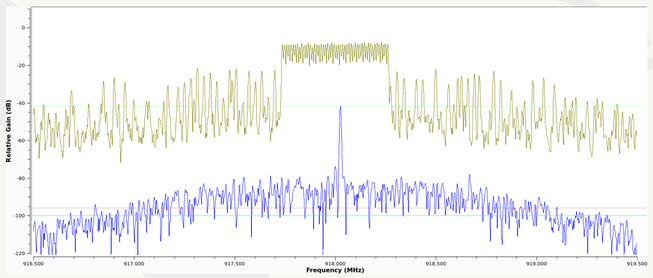



Figure 5. Diagram showing a potential agricultural logistics application of the wireless tag technology.

## Explain

- A wireless tag is a device that can be placed upon a product which can then send information including sensor data (such as temperature).
- The bridge is a device which wirelessly sends power to the tags so they can sense and broadcast their data. The bridge can also listen and retransmit the signals to allow further transmission distances.
- The data is received by a gateway device which then uploads the encrypted data to the cloud so it can be decrypted. A gateway device can be connected via Wi-Fi or a cellular network such as 5G.



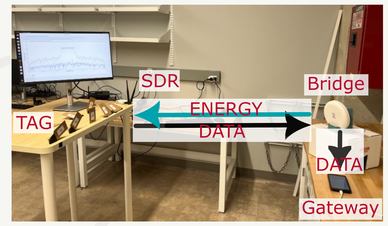




Figure 6. Spectrum analysis at 918Mhz of a Wiliot Bridge Device (Spectrum Output on left and Setup on Right) The blue trace is the instantaneous response and the gold trace is the maximum hold.

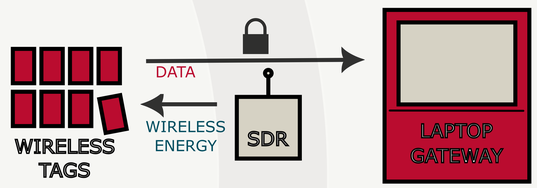




Figure 7. Setup of an experiment to wirelessly power a tag with a SDR (Diagram on Left and Setup on Right)

## Enrich

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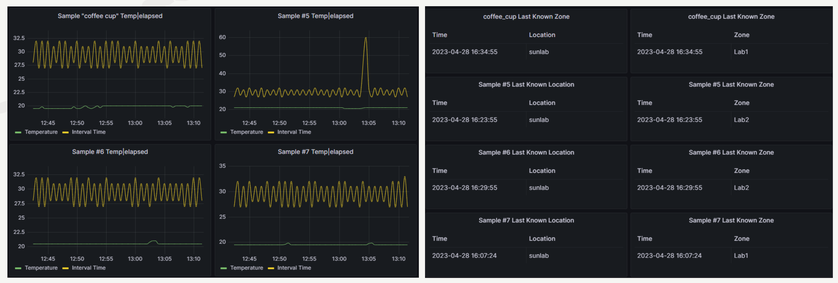


Figure 8. These graphs on the left show the temperature decoded from four tags, and the interval between each update. The right shows the last updated location and zone for each tag.