

# Transmission Reliability of Implantable Wireless Temperature Loggers for Laboratory Rats



Ásgeir Bjarnason<sup>1,2</sup>, Hákon Guðmundsson<sup>2</sup>, Sigurður Gunnlaugsson<sup>2</sup>, Andrés Gunnarsson<sup>2</sup>, Kjarran Sveinsson<sup>2</sup>, Sigmar Guðbjörnsson<sup>2</sup>

1 Tampere University of Technology, Department of Electronics and Communication Engineering, Korkeakoulunkatu 3, Tampere, Finland  
2 Star-Oddi Ltd. Garðabær, Iceland  
E-mail: asgeir.bjarnason at tut.fi , sigmar at star-oddi.com

## Objectives

- To measure the transmission reliability of low-power implantable wireless temperature loggers in laboratory rats.
- To test and verify a simple method that enhances the reliability of the wireless transmission.
- To measure the transmission power and pattern of the system.

## Results

Transmission throughput was initially measured at 94% on average ranging from a minimum of 87% to a maximum of 97% transmitting a single measurement (n).

By sending three measurements (n, n-1, n-2) it was possible to increase the reliability of the transmission up to 98.4% on average (min=97.7%, max=98.8%).

## Methods

Each cage has an antenna placed below it and an RF box. Every receiver can handle up to 10 subjects per cage. The RF box sends information to the PAN.



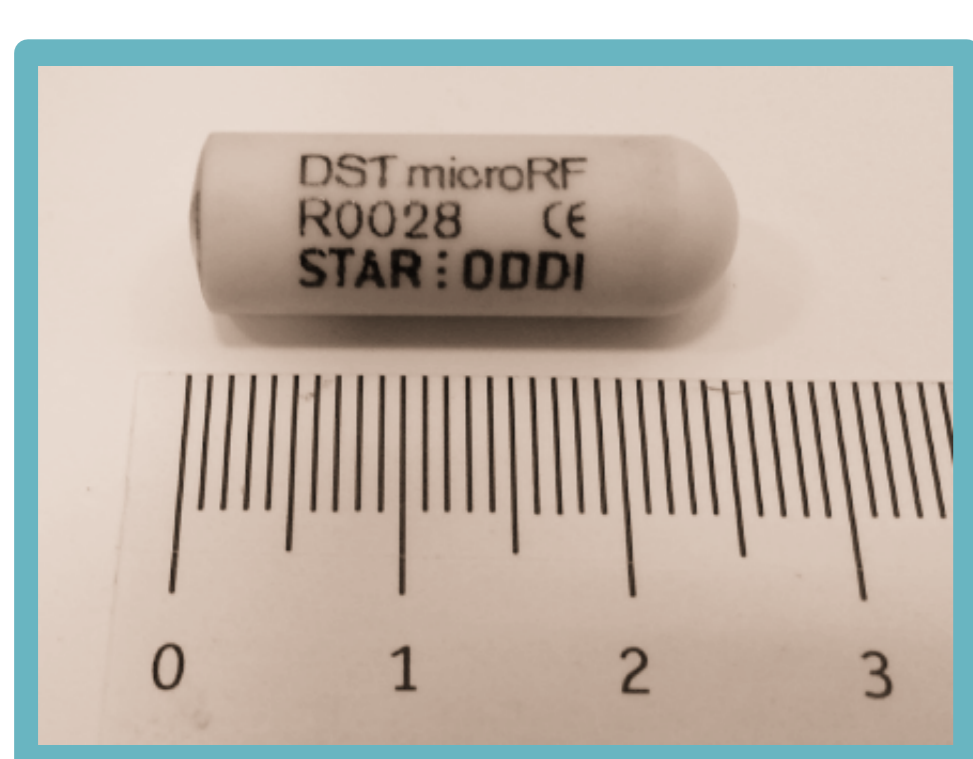
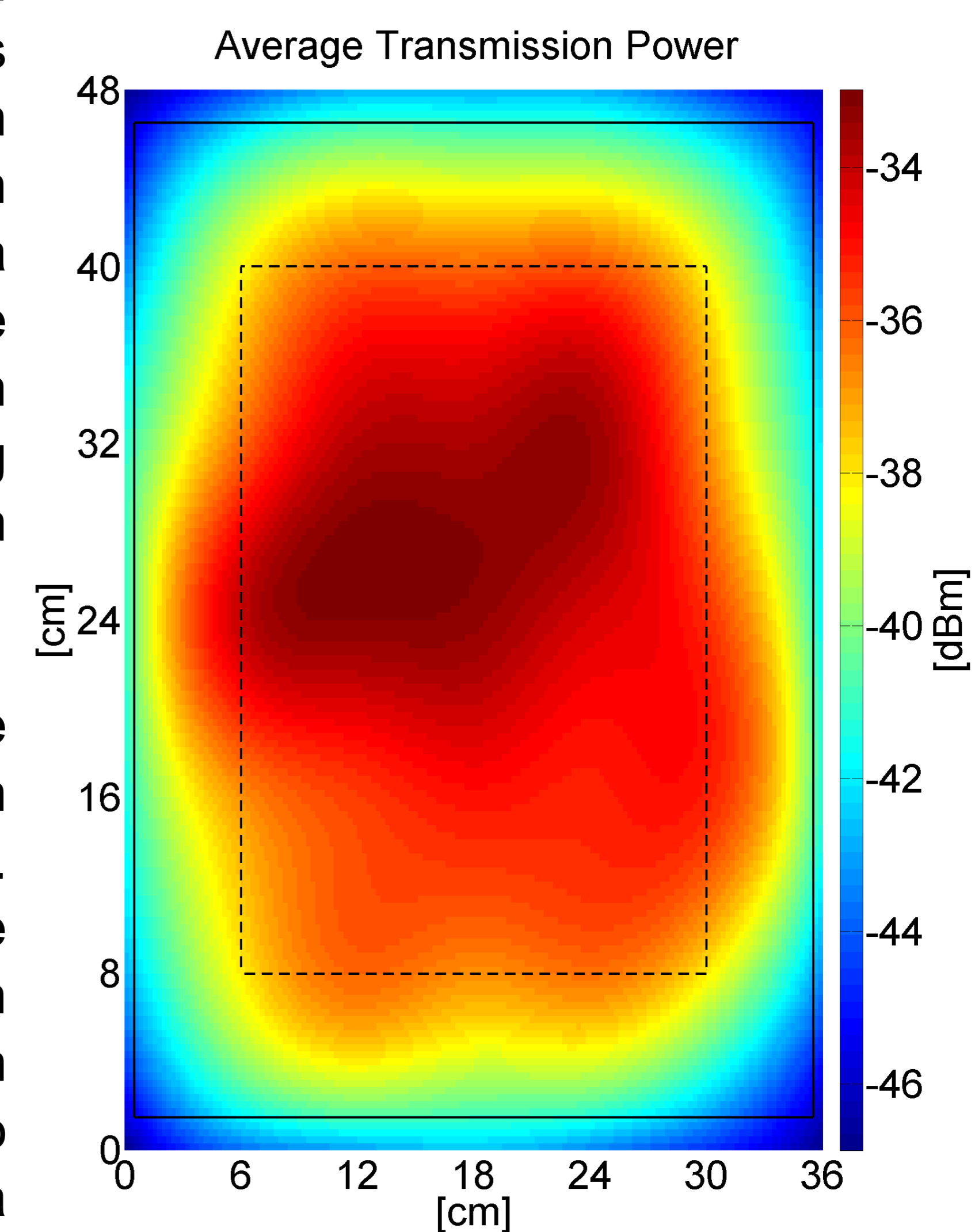
PAN is connected to computer via USB. It receives a signal from the RF box attached to each cage. Every PAN can handle up to 64 RF boxes.

The RF transmission is done through a custom-made protocol that uses a 500kHz output frequency to send the ID, temperature data and CRC. In transmission mode the average current consumption is 2.5mA. The receiving antenna placed under the cage in the experiments measured 250x350mm.

The 500kHz frequency band is chosen since it offers a trade-off between power, bandwidth and losses due to the biological tissue. To improve the throughput of transmission a simple method was developed, where the three last measurements (n, n-1, n-2) are sent with each transmission instead of a single measurement (n).

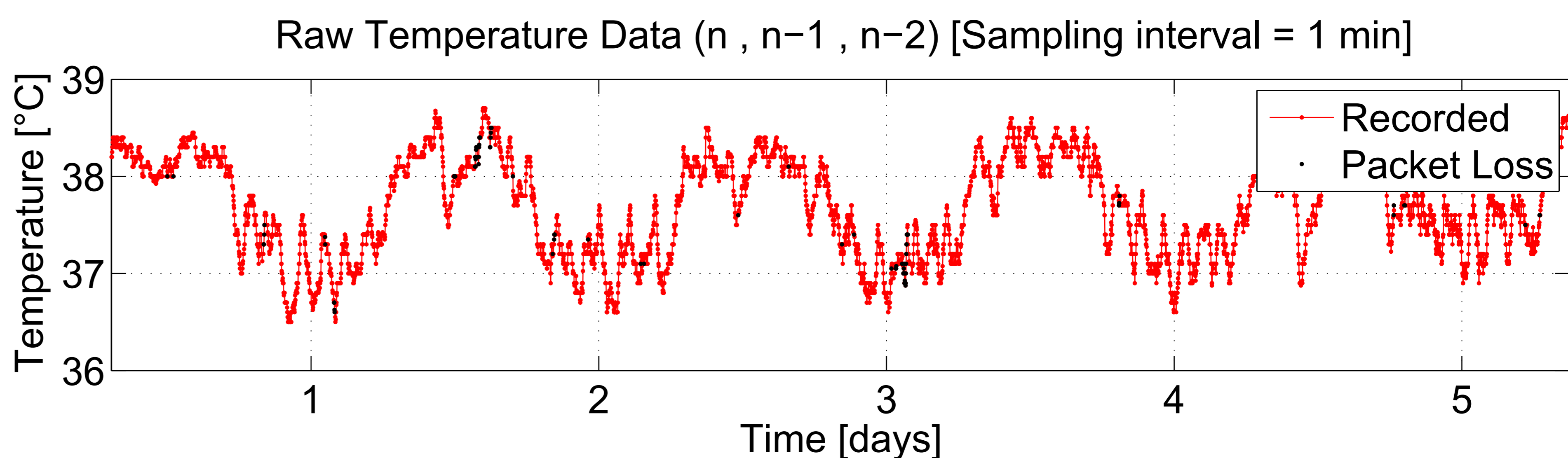
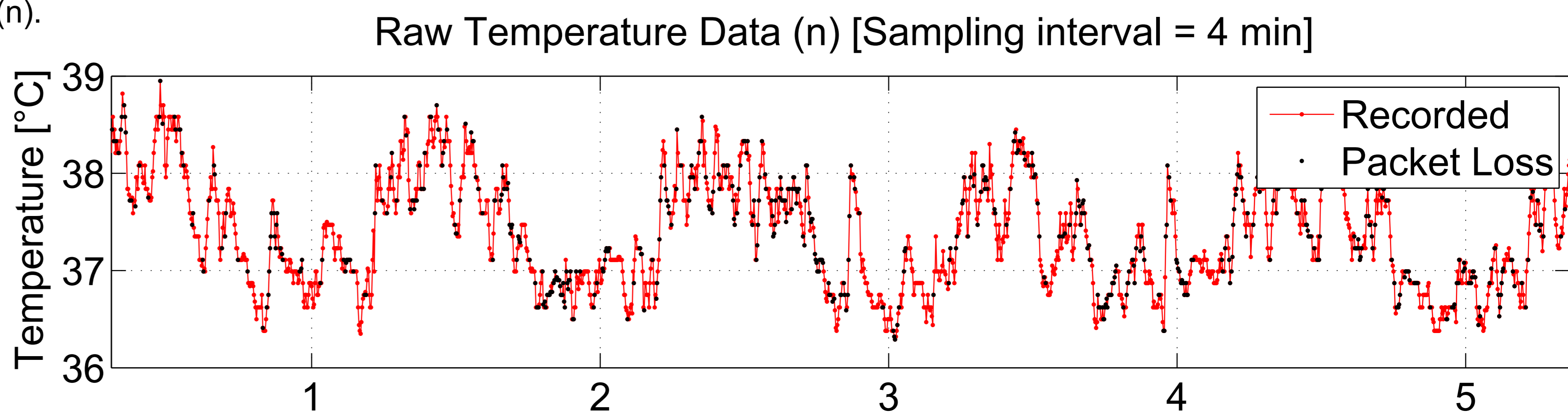
The average transmission power inside of the rat's cage was measured with an unamplified receiver in free space conditions at a -38.53dBm where the strongest transmission was inside the receiving antenna's loop -35.5dBm on average.

Once implanted the absolute transmission power decreases slightly. On the other hand the transmission pattern becomes more uniform and is not as vulnerable to orientation of the antenna as in free space conditions.



The RF data storage tag (DST) is in a cylindrically shaped ceramic capsule (dimensions: 8.3x25.4mm) filled with bio-compatible epoxy. It weighs 3.3gr including a non-rechargeable battery.

Scale on the figure is in cm



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