

Technology for catching data on animal movement

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Let's play some games!

- Pink and Yellow posters with numbers
- Different zones
- Timer (System clock) says "BEEeeP"+number (1,2,3...)
- Note

Game 1: Stand by me

- Roles:
 - 2 people wear **Pink** posters; the rest wear **Yellow**. **Pink** have notes.
 - **Pinks** stand still in “gate zones”.
 - **Yellows** Free to move around the room.
 - **Timer** every 20 second says “BEEeeP” “+number (1,2,3...)”
- Instruction:
 - **Pink** can only log data when the timer beeps. When the beep happens, **Pink** check if any **Yellow** is within arm length, if so, writes: (time, IDs of Yellow inside their reach)
Example: Time 1 → Animals 5, 7

RFID



(a) RFID reader module



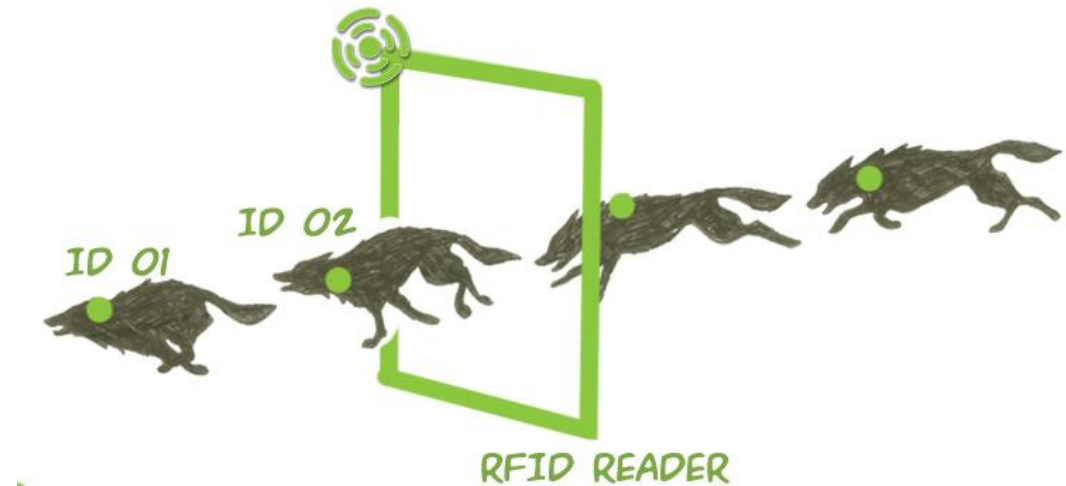
(b) RFID reader antenna



(c) Ear tag RFID transponder



(d) Implant RFID transponder



Tracking and identification of animals for a digital zoo Karlsson et.al.
2010

Game 2: Closer to You

- Roles:
 - 8 **Yellow** free moving.
 - **Timer** say "BEEeeP" "+number (1,2,3...) every 20 seconds
- Instructions:
 - Every time the timer beeps, **Yellow** looks around
 - If **another Yellow** is within arm length → both write down each other's ID.
Example log for Animal 3: T=1 → Contact with 7;
T=3 → Contact with 2, 5.

Bluetooth Proximity

- The tag broadcasts its unique ID.
- Gateways within range receive the signal.
- The recorded **signal strength** is used as a proxy for distance (e.g., strong \approx within 1–2 m, weak \approx >5 m).

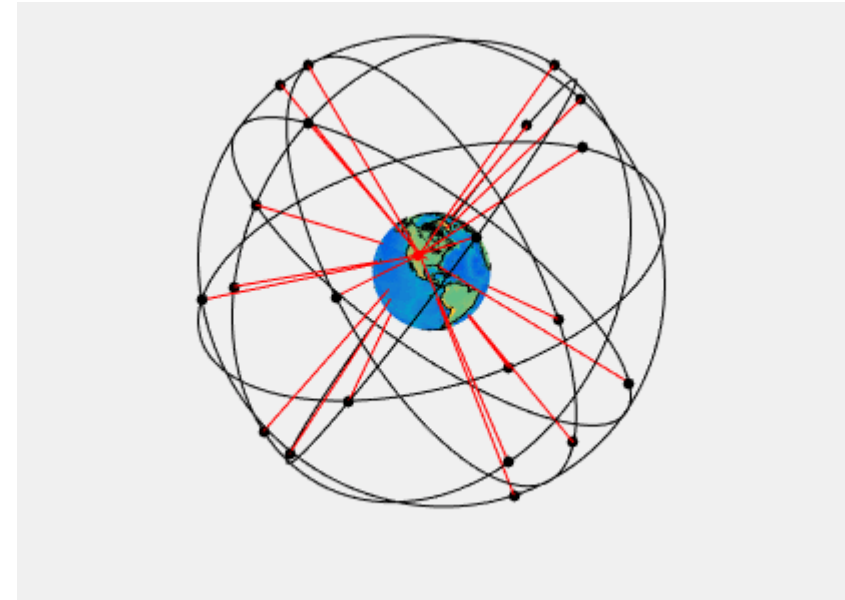


Game 3: Talker and Listener

- Roles:
 - 4 people wear **Pink** posters and one of them is **Pink_0**. **Pink** stand in each corner the room.
 - 1 **Yellow** free moving. **Yellow** have note.
 - **Timer** say "BEEeeP" "+number (1,2,3...) every 20 seconds
 - 4 Zones
- Instructions:
 - Every time the timer beeps, **Yellow** says "Attention!"
 - **Pink** receiver who can see **Yellow** directly raises a hand
 - If **Yellow** could see at least 3 raised hand, write down (time, zone they are standing in)
Example: T=1 → Zone 1
 - At the end, **Yellow** sends the note to **Pink_0**.

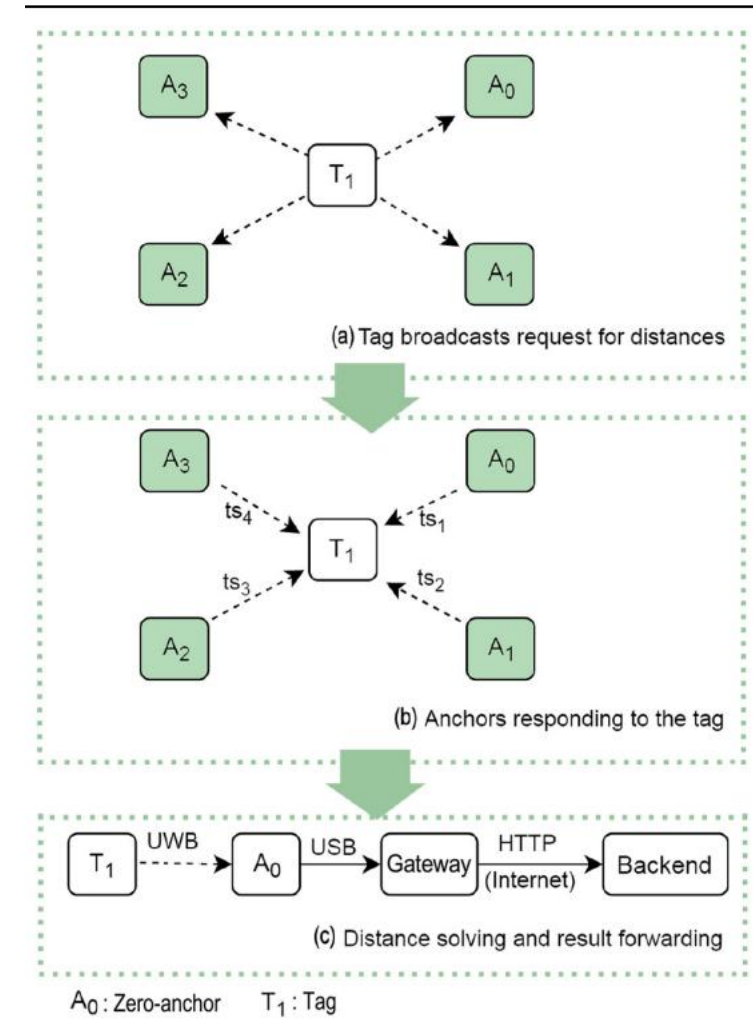
Transmitters, Receivers

- Radio Telemetry: global positioning system (GPS) tracking, Satellite-Based Argos.



Transmitters, Receivers

- Ultra-wideband (UWB)



A sensor-fusion-system for tracking sheep location and behaviour, Ren et al. 2020

Time of Flight(TOF) and Time Difference of Arrival (TDOA)

TOF Mode (Two-Way Ranging)

- Timer says “BEEP.”
- Yellow (tag) shouts “**Ping to Anchor 1!**” (e.g., Pink in corner 1).
- Anchor 1 replies “**Pong!**” after a short delay.
- Yellow writes in notebook: (time, Anchor 1, measured distance) → pretend to calculate distance based on how long the “round trip” took.
- Repeat for all anchors one by one.

TDOA Mode (One Broadcast)

- Timer says “BEEP.”
- Yellow shouts once: “**Ping to ALL Anchors!**”
- All Pink anchors raise hands *at slightly different times* (you could number them 1–4, and each raises hand with a 1–2 second offset).
- Anchors tell Pink_0 (base station) when they got the signal (T=5.0s, 5.2s, 5.3s, etc.).
- Pink_0 triangulates position based on *differences*.

Game 4: Now I can see you

- Roles
 - 1 **Pink** stand in the corner, with two paper shields, keeping the eyesight 120 degrees. 5 **yellow** free moving.
 - **Timer** say "BEEeeP" "+number (1,2,3...) every 20 seconds
- Instruction
 - **Pink** speaks loudly of the time number and everything they see

Cameras

- Identification and tracking



Low vs. High Frequency Radio Signals

Low Frequency

- e.g. RFID at 134.2 kHz
- Long wavelength, penetrates materials (skin, muscle, walls) fairly well, but carries less data, short range.

High Frequency / Ultra-High Frequency

- UHF / GHz e.g. Bluetooth, UWB, GPS
- Shorter wavelength, higher data capacity, but blocked more easily by walls, trees, or animal bodies.

Bandwidth

- **Frequency vs. Bandwidth**

- **Frequency** = *where on the spectrum you are* (e.g., 134 kHz for RFID, 2.4 GHz for Bluetooth).
- **Bandwidth** = *how much spectrum you use around that frequency.*

- **Narrowband vs. Wideband vs. Ultra-Wideband**

- **Narrowband (RFID)**: carries little information.
- **Wideband (Wi-Fi, Bluetooth)**: Uses more spectrum. Can carry more data, better for communication.
- **Ultra-Wideband (UWB, 3.5–6.5 GHz, 500 MHz+ bandwidth)**: Uses a *very wide slice of spectrum*.
 - Allows very short pulses → extremely accurate time measurements.
 - That's why UWB can calculate distance down to **10–30 cm** indoors.