

# Device-Free Indoor Localization Using Ambient Radio Signals

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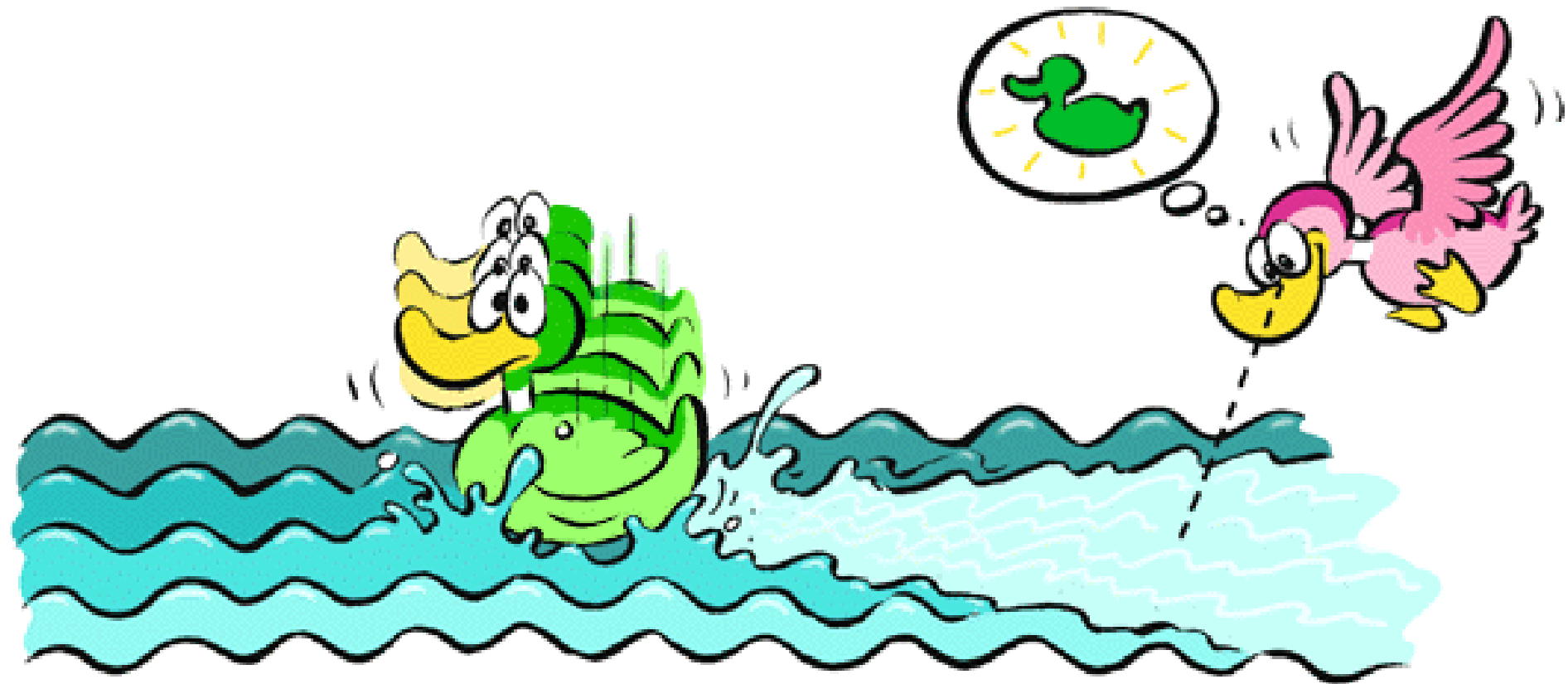


Device-based positioning



Localizing cows for 4000 years

# Device-free sensing

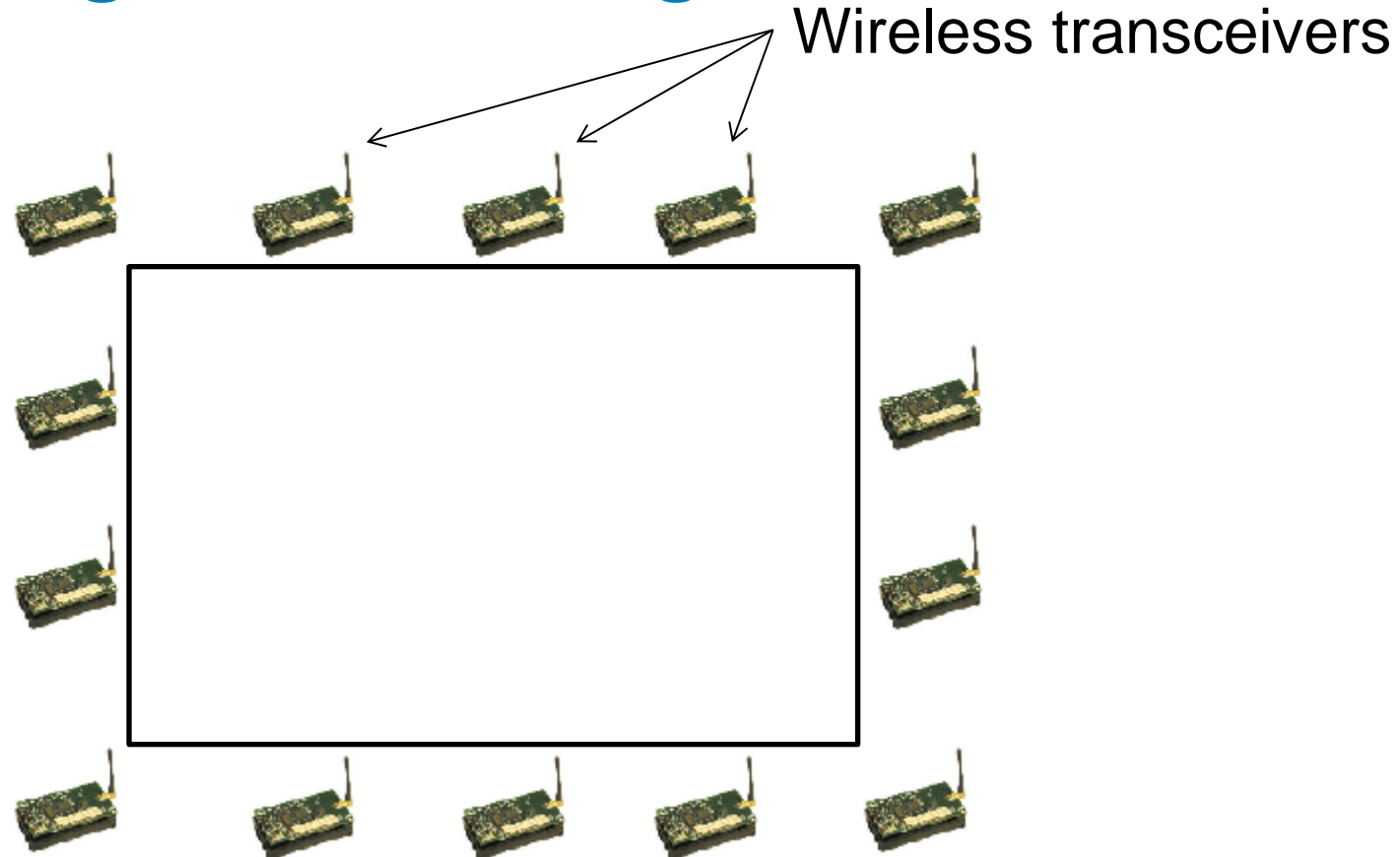


# Device-free sensing

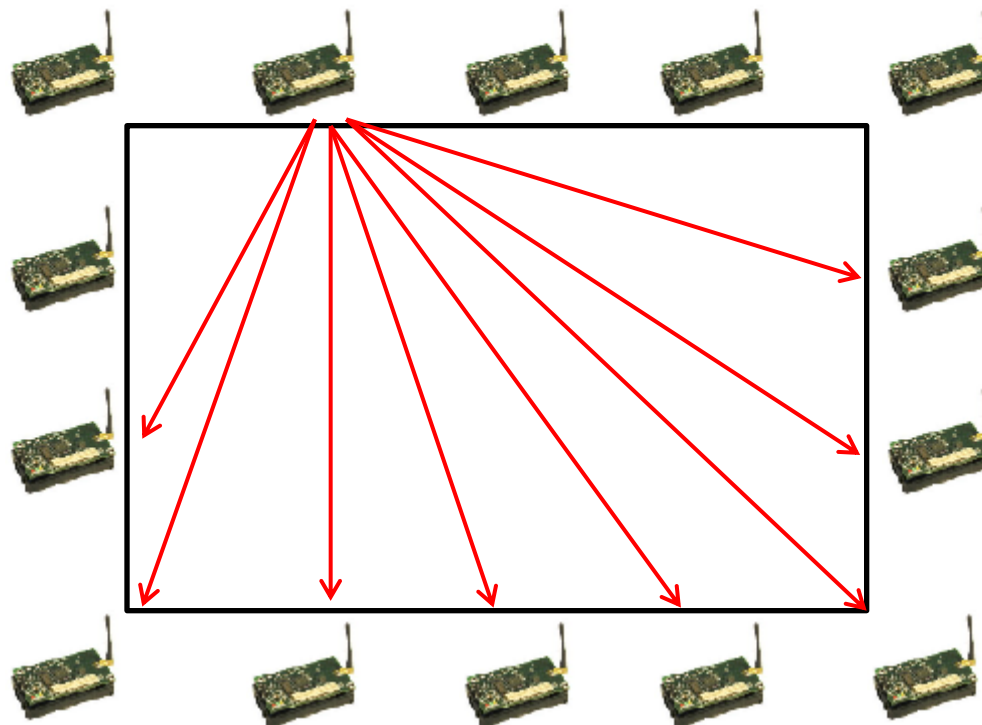
- User freedom
  - Nothing to carry
- Research freedom
  - More computational resources at hand
  - Unlimited grid power, not battery
  - More antennas



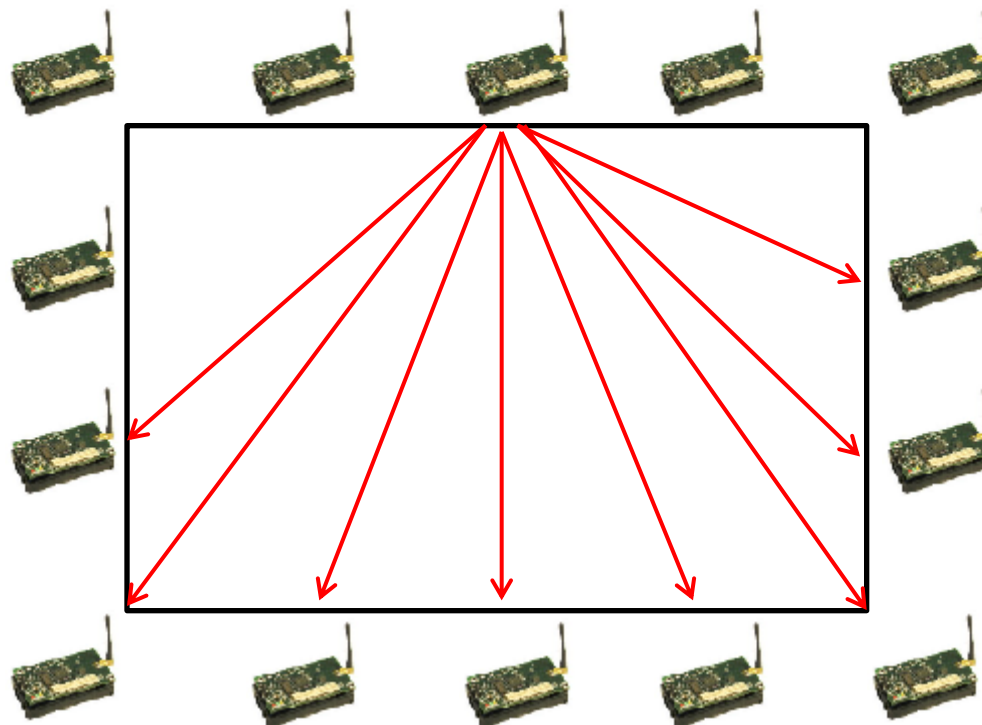
# State of the art: Line-of-sight shadowing



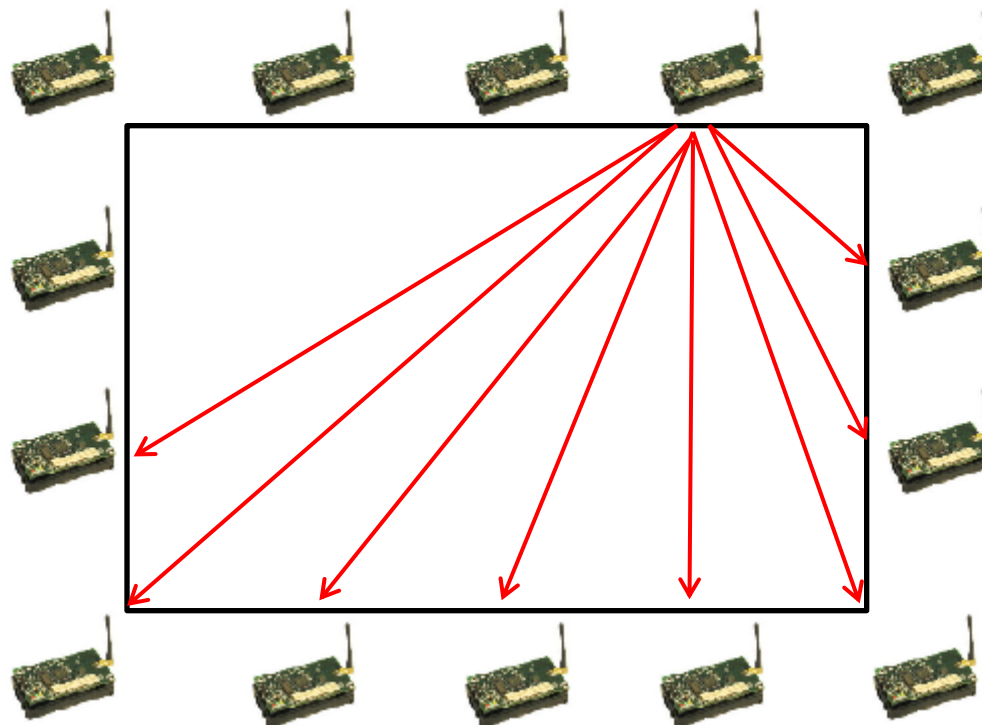
# State of the art: Line-of-sight shadowing



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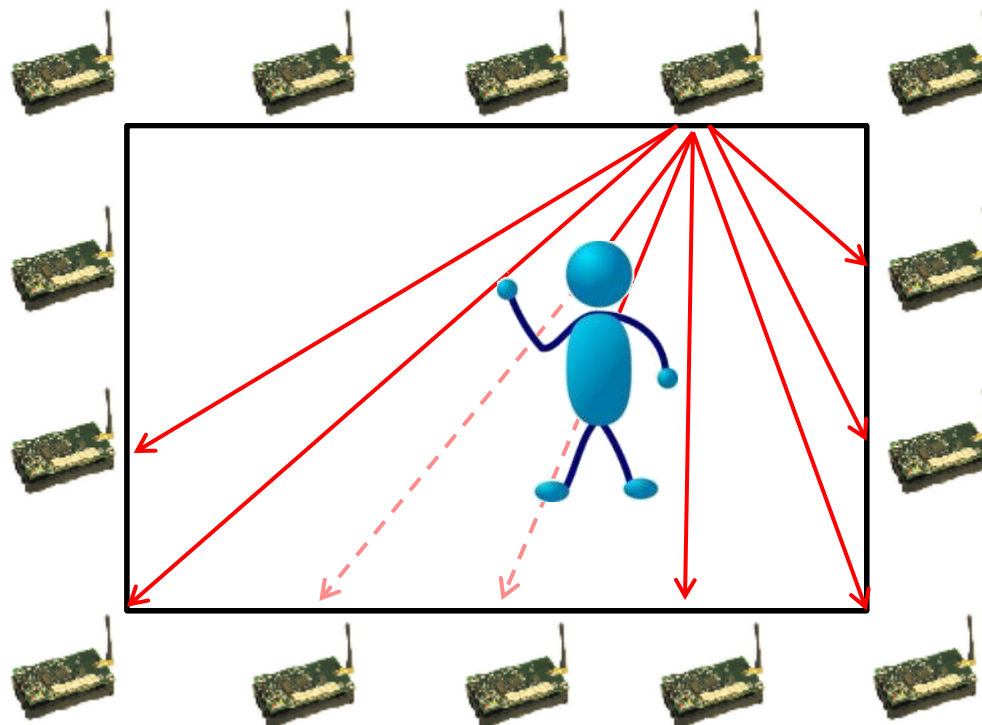



# State of the art: Line-of-sight shadowing





# State of the art: Line-of-sight shadowing

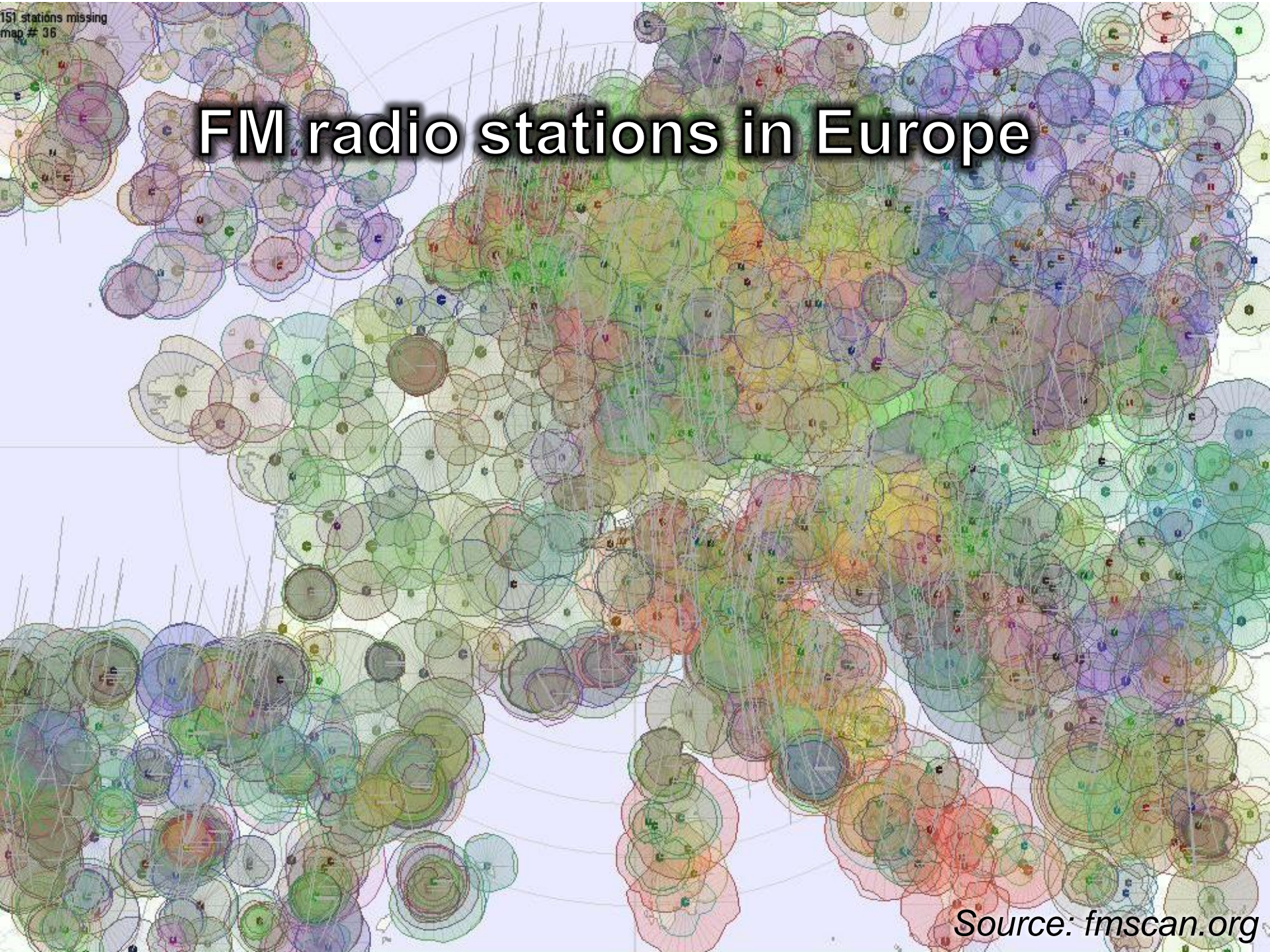


The image shows a top-down view of 25 small, green printed circuit boards (PCBs) arranged in a 5x5 grid on a light-colored wooden surface. Each board is populated with various electronic components, including a microcontroller, several resistors, and two LEDs: a red one and a blue one. The boards are interconnected by a network of thin, brown insulated wires. Some boards have small white labels with letters like 'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l', 'm', 'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w', 'x', 'y', 'z' printed on them. The overall scene suggests a complex, interconnected system of many small devices.

**Too many  
devices!**

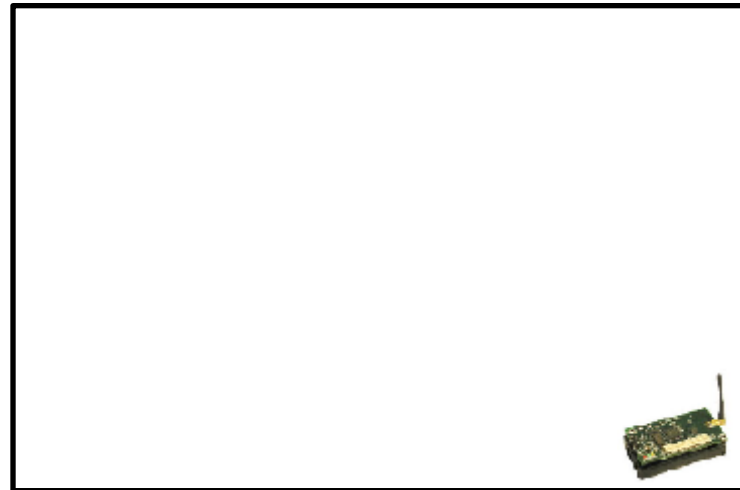


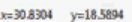
# FM radio stations in Europe



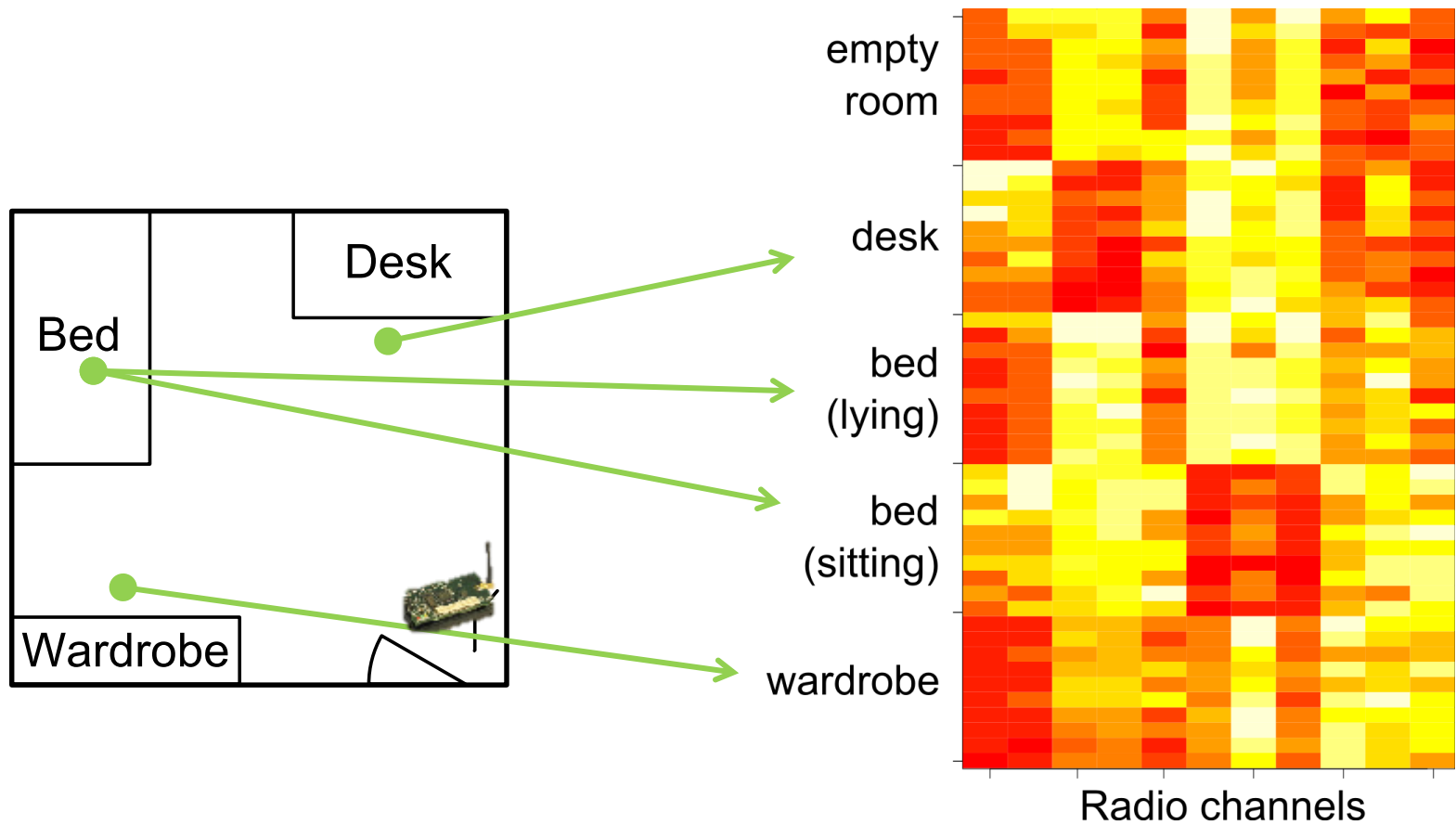


# Ambient radio sensing





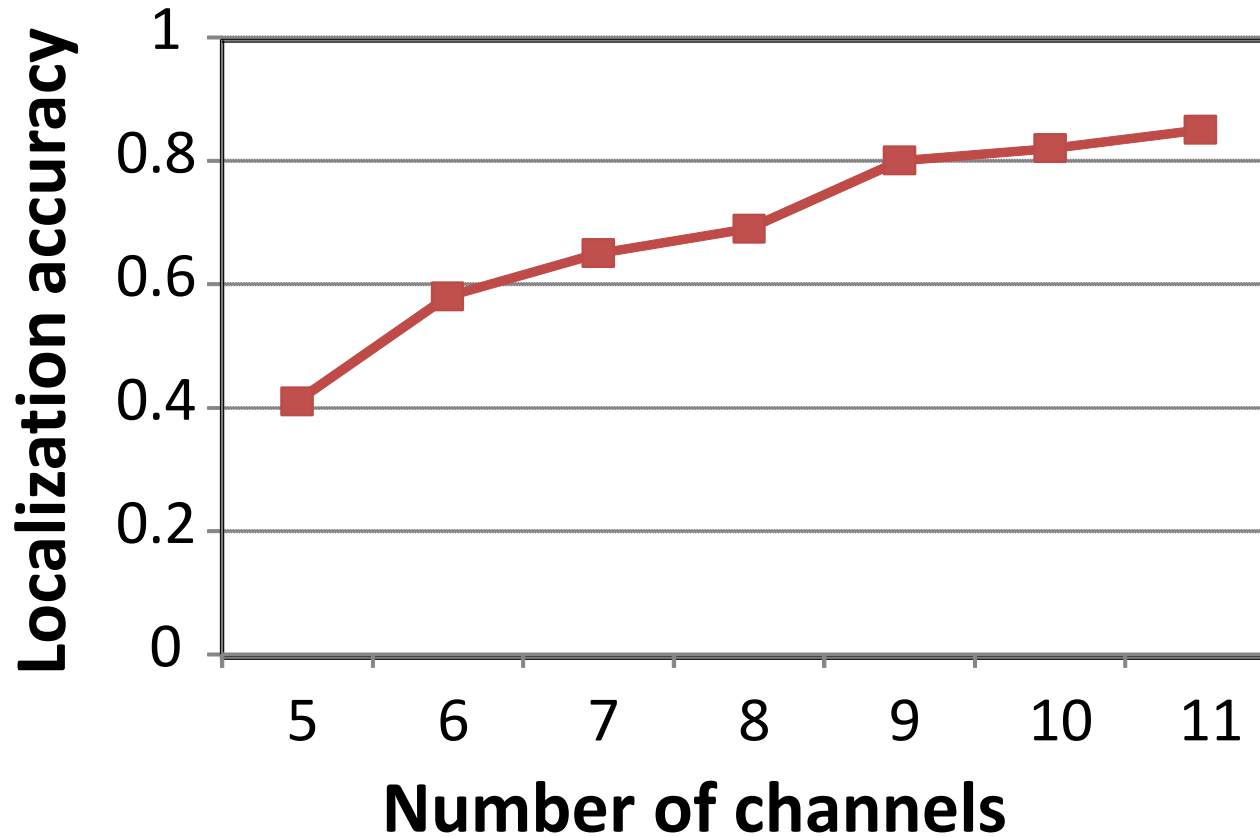
# Sample dataset



# Localization performance

- 4 days, 2 datasets daily
- 85% same-day accuracy
- 65% three days later  
*(still better than 20% of random guess)*

# The more stations – the better





# Summary

- Device-free localization with ambient radio is feasible
- Frequency diversity is essential

# Thank you!

