Device-Free Indoor Localization Using Ambient Radio Signals

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Device-based positioning
Localizing cows for 4000 years

Device-free sensing

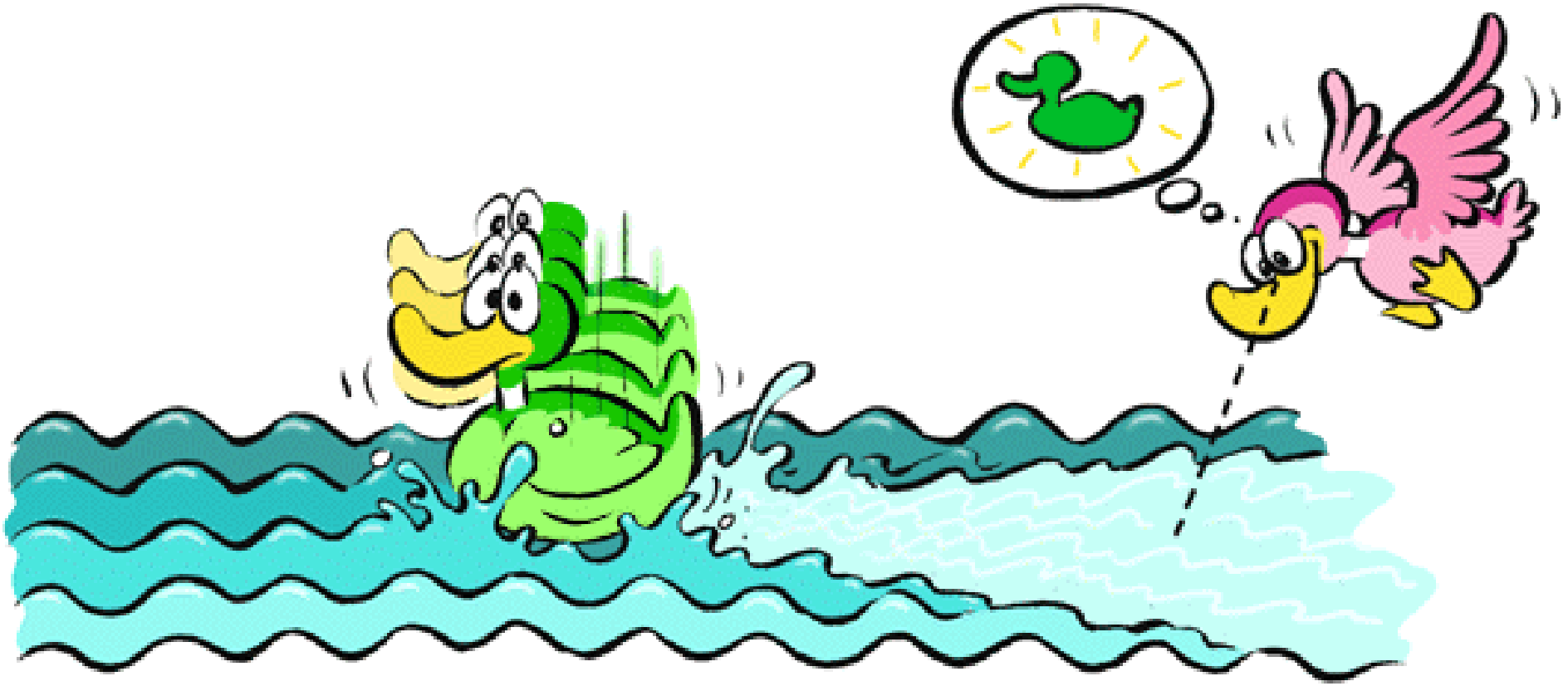
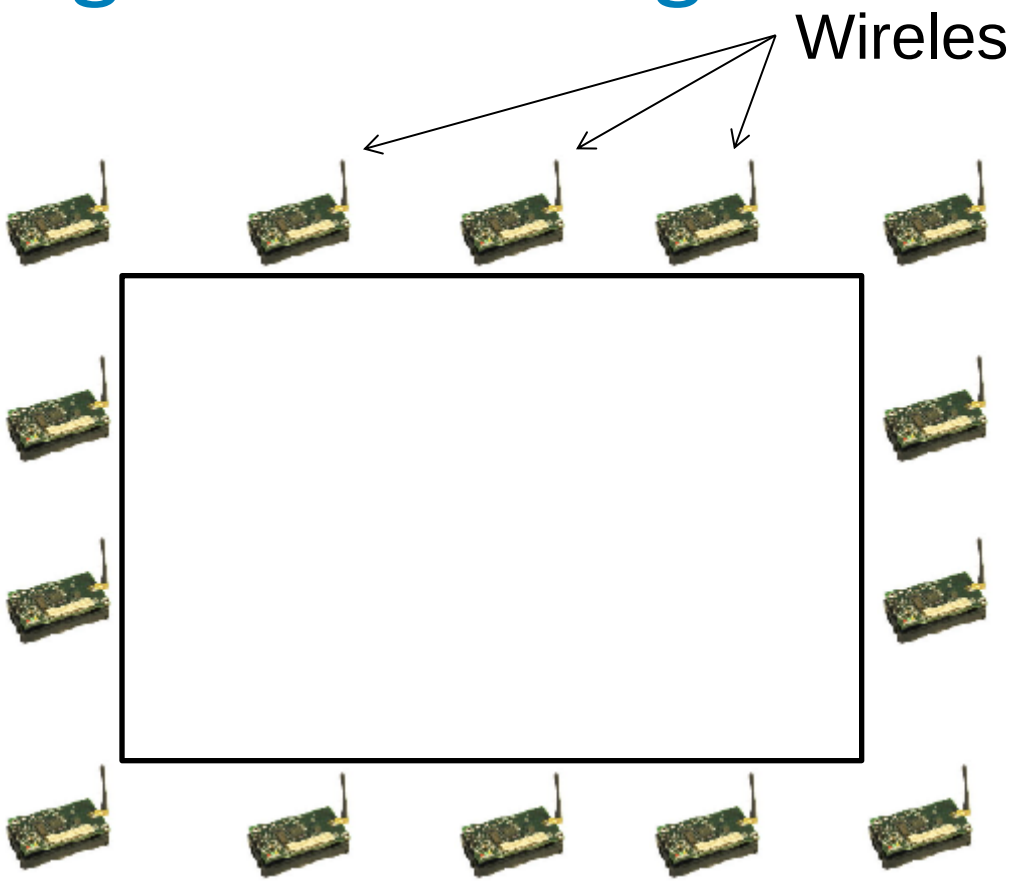


Image: Particle physics education CD-ROM, 1999 CERN.

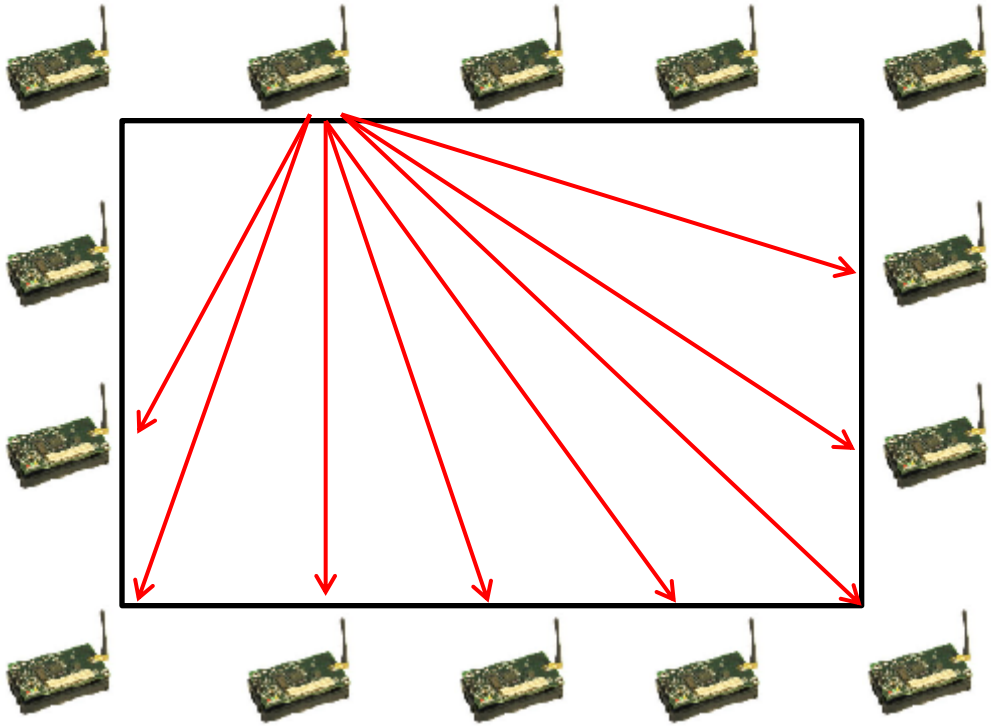
Device-free sensing

- 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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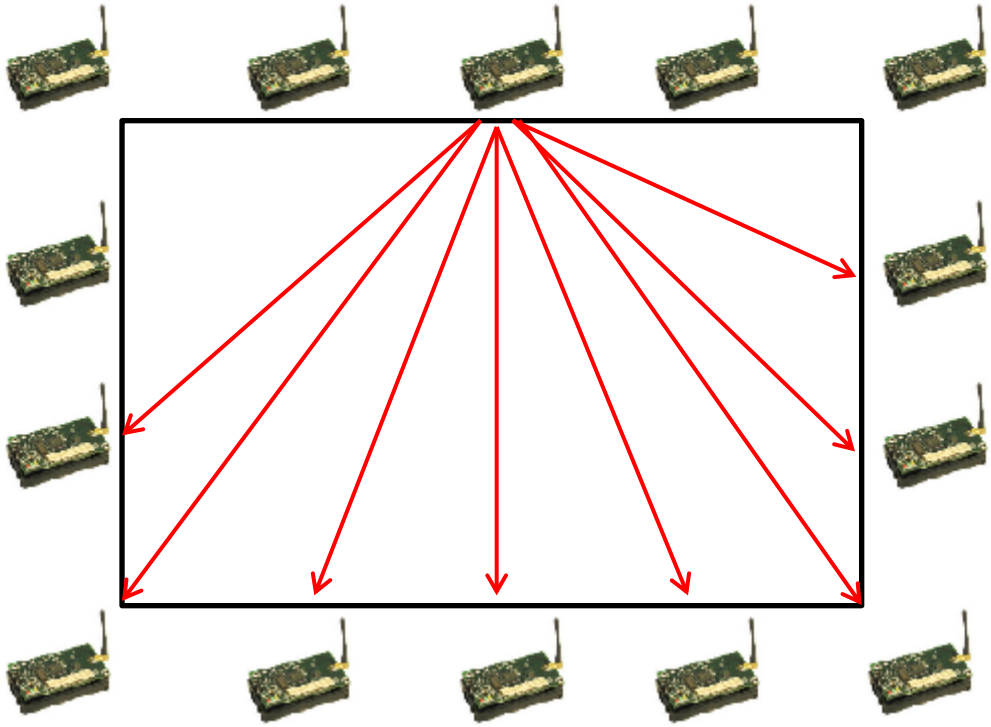

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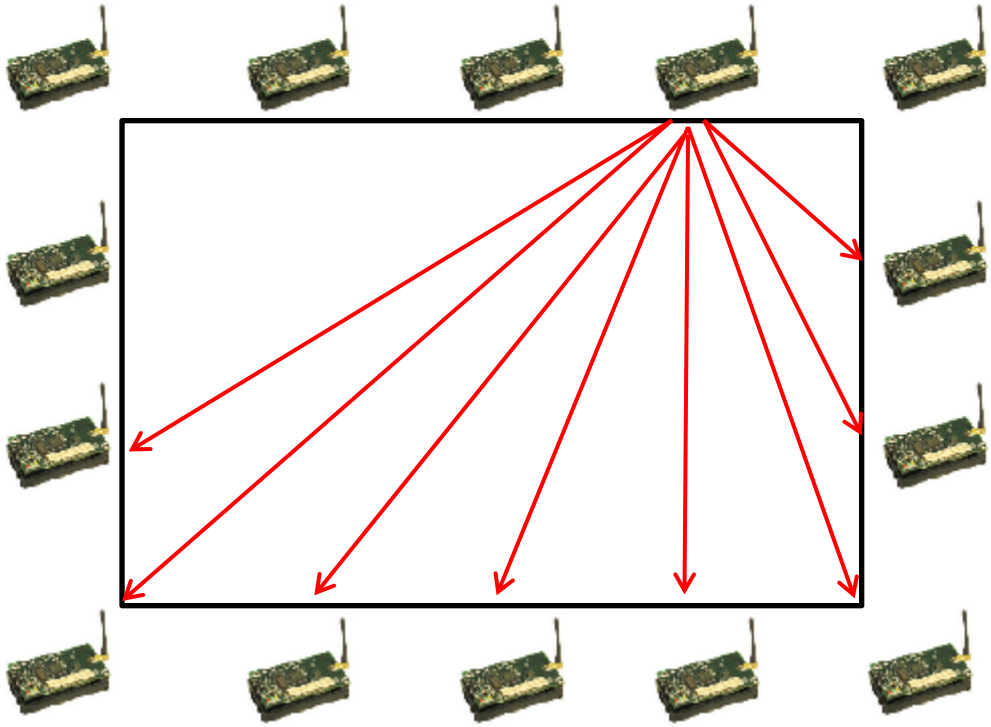
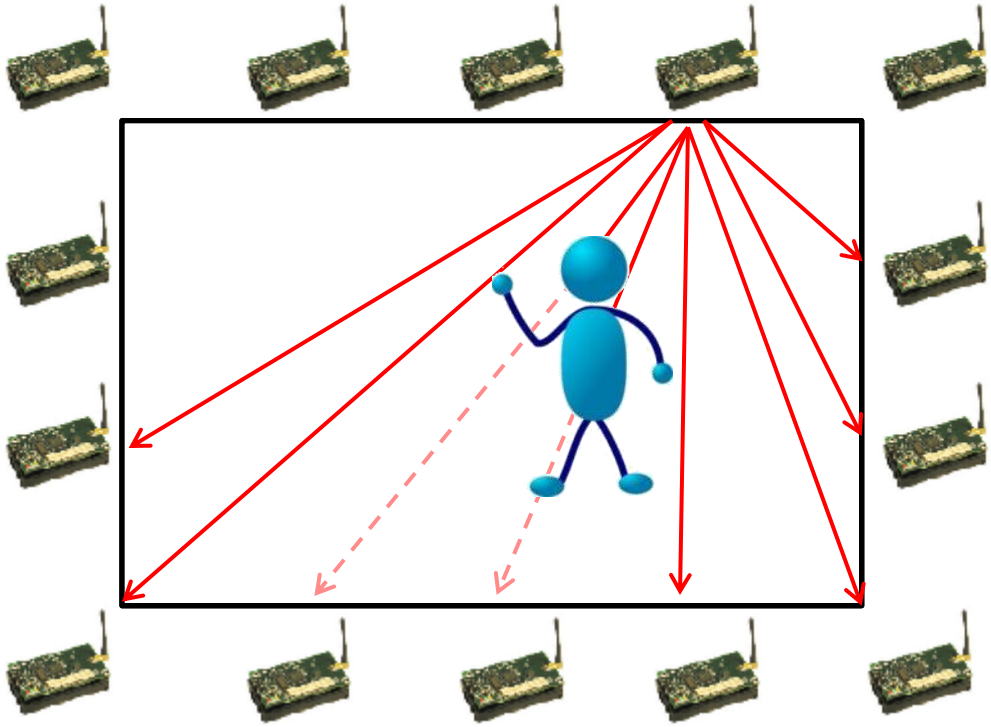
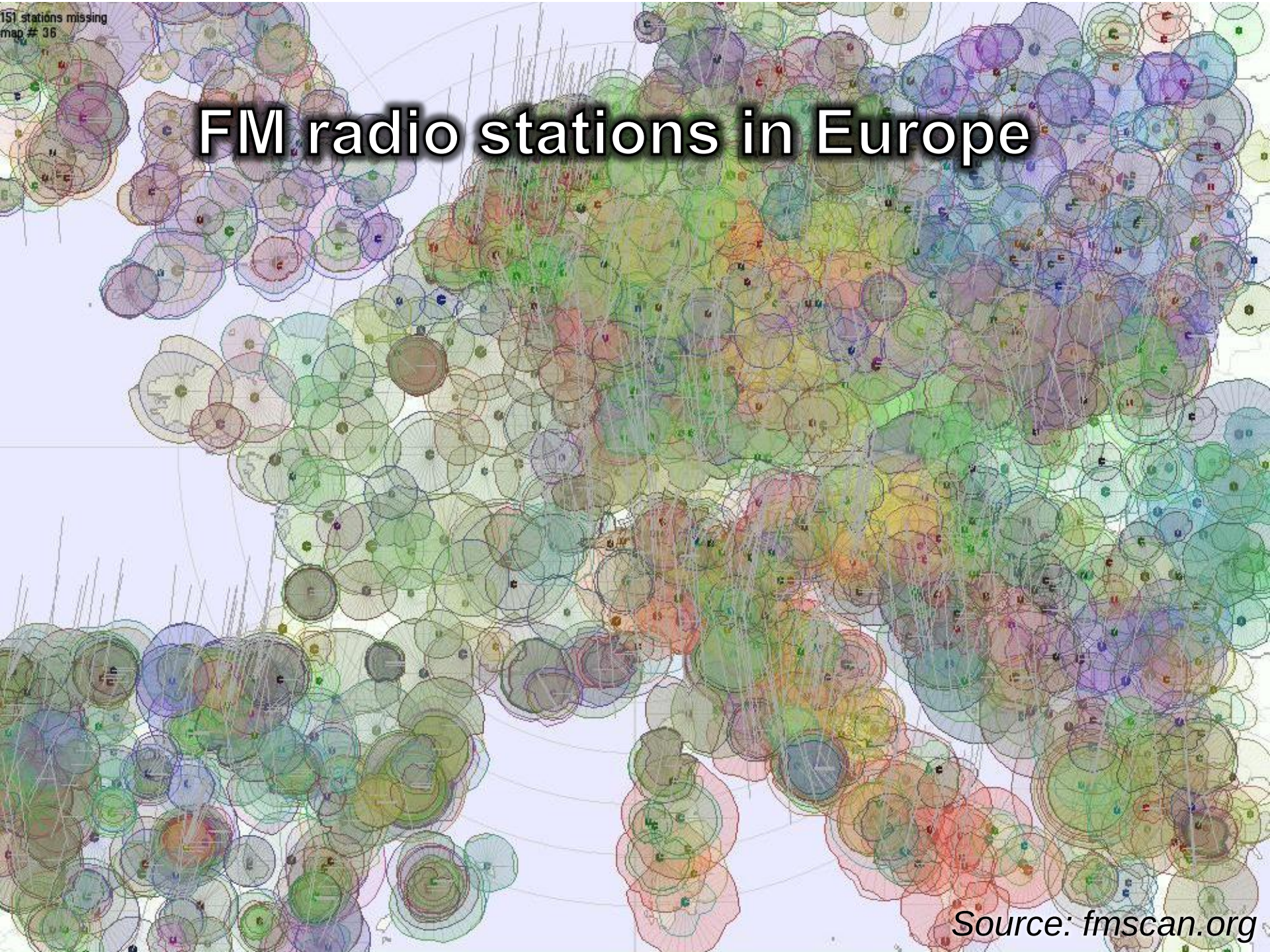


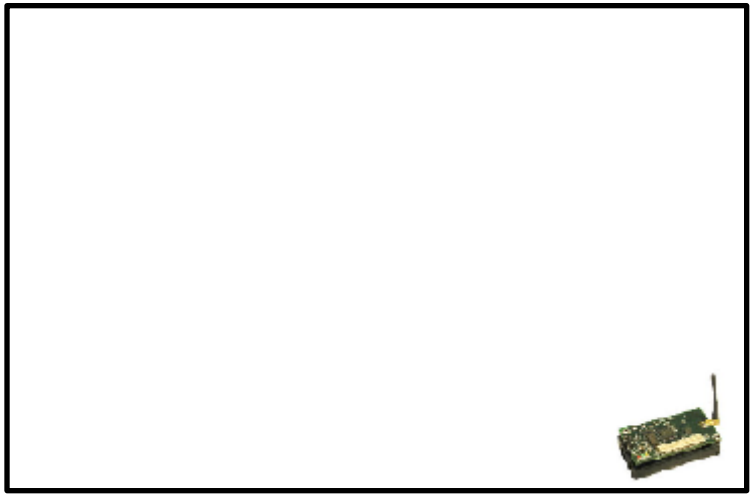
State of the art: Line-of-sight shadowing




Too many
devices!

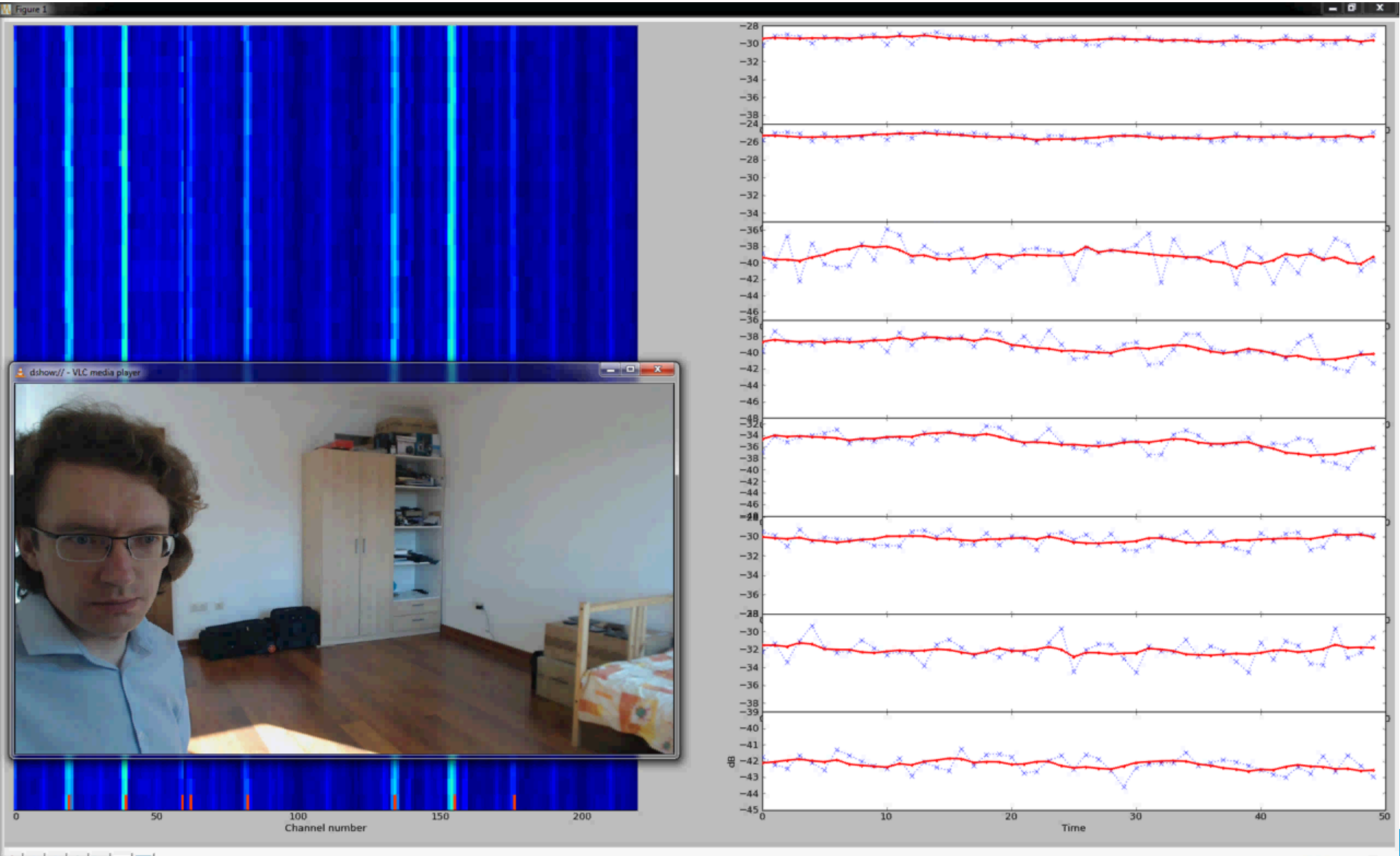

151 stations missing
map # 36
FM radio stations in Europe
Source: fmscan.org

Ambient radio sensing

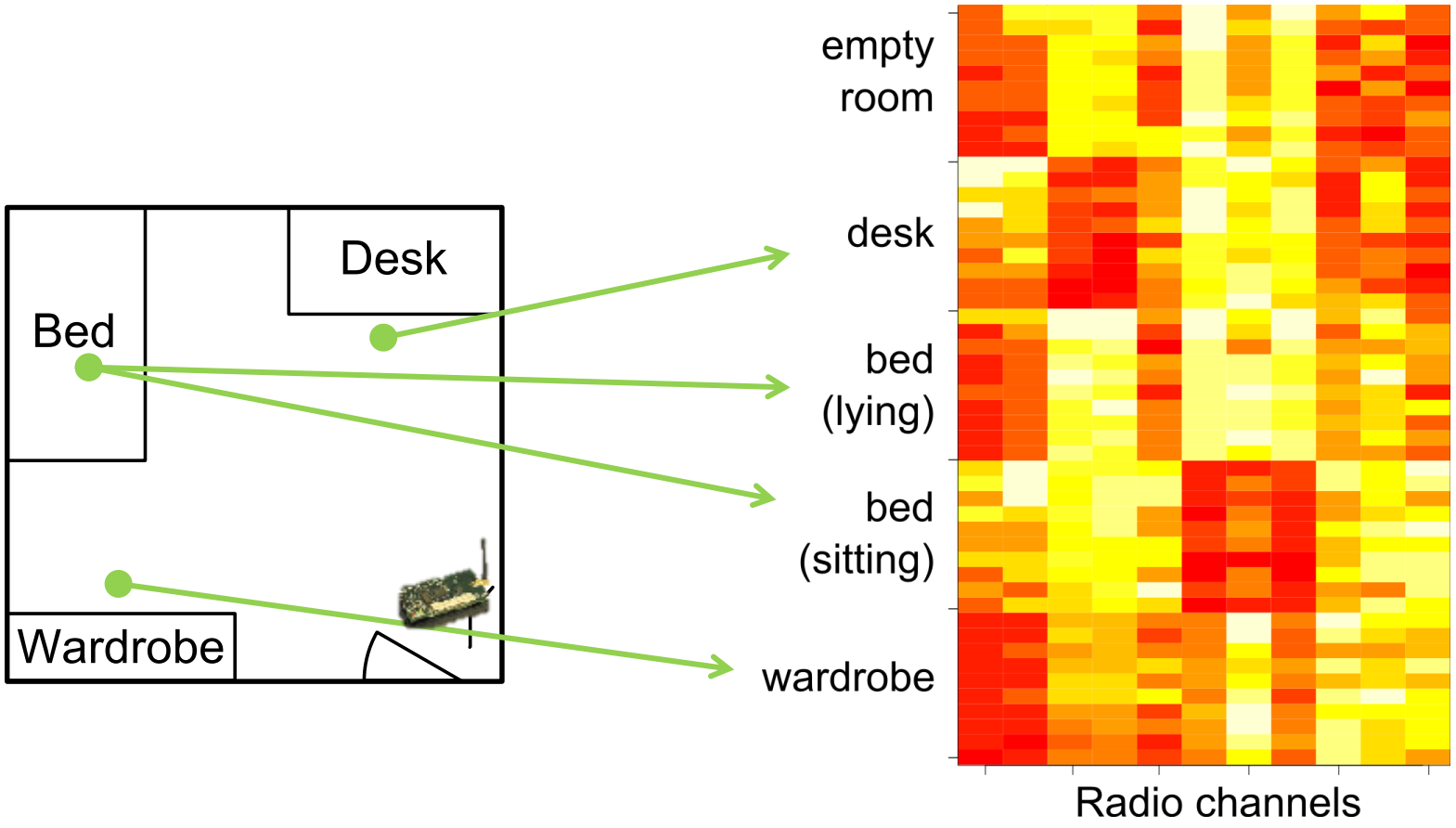


Proof of the concept (video)

securityandtrust.lu



Sample dataset



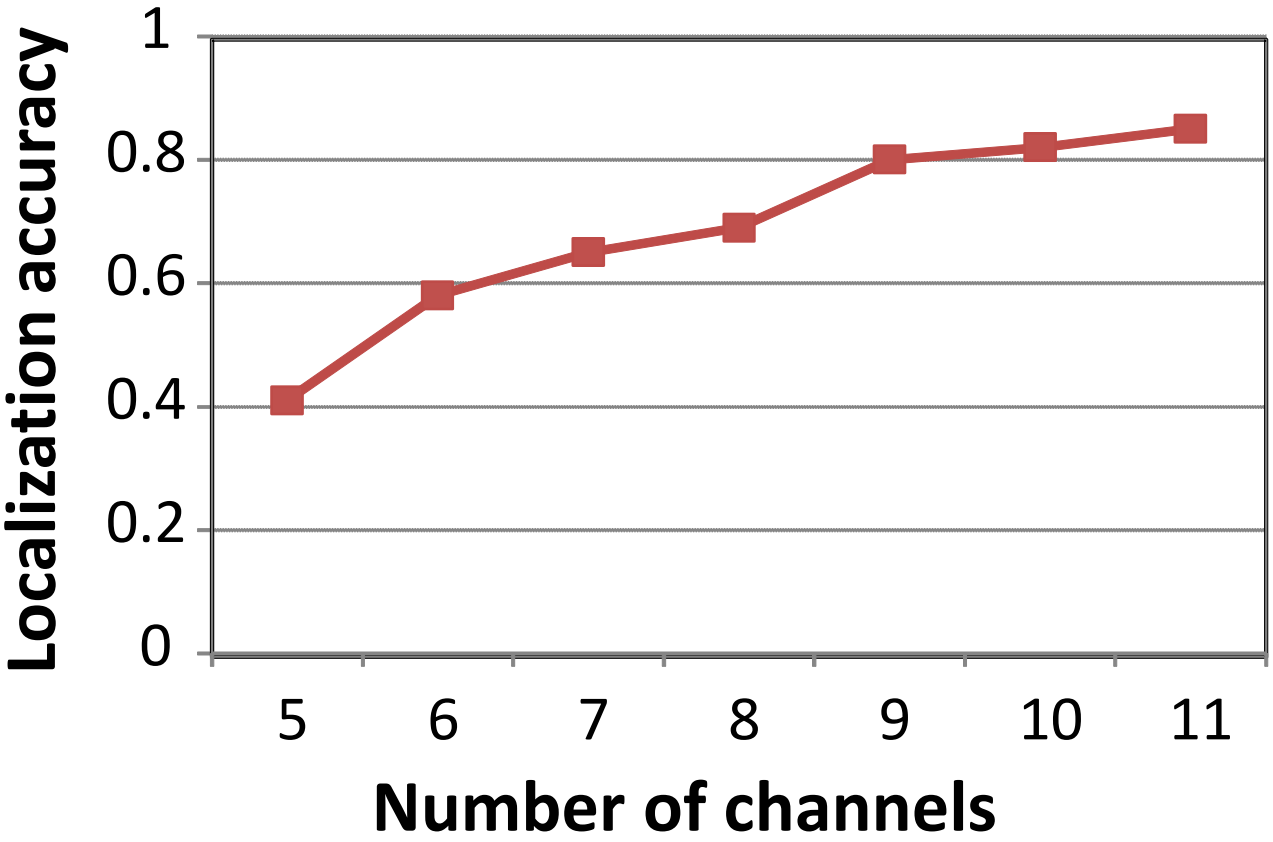
Localization performance

- 4 days, 2 datasets daily

- 85% same-day accuracy
- 65% three days later

  (still better than 20% of random guess)

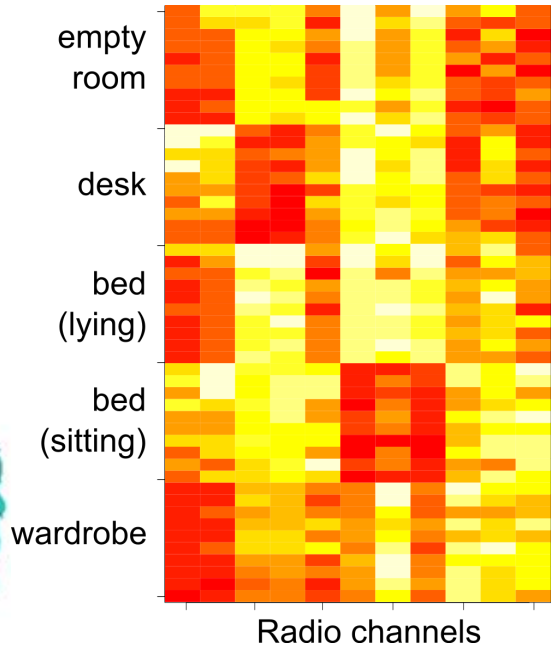
The more stations – the better



Summary

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

Thank you!


empty room
desk
bed (lying)
bed (sitting)
wardrobe
Radio channels