



FINDR: Low-cost indoor positioning using FM radio

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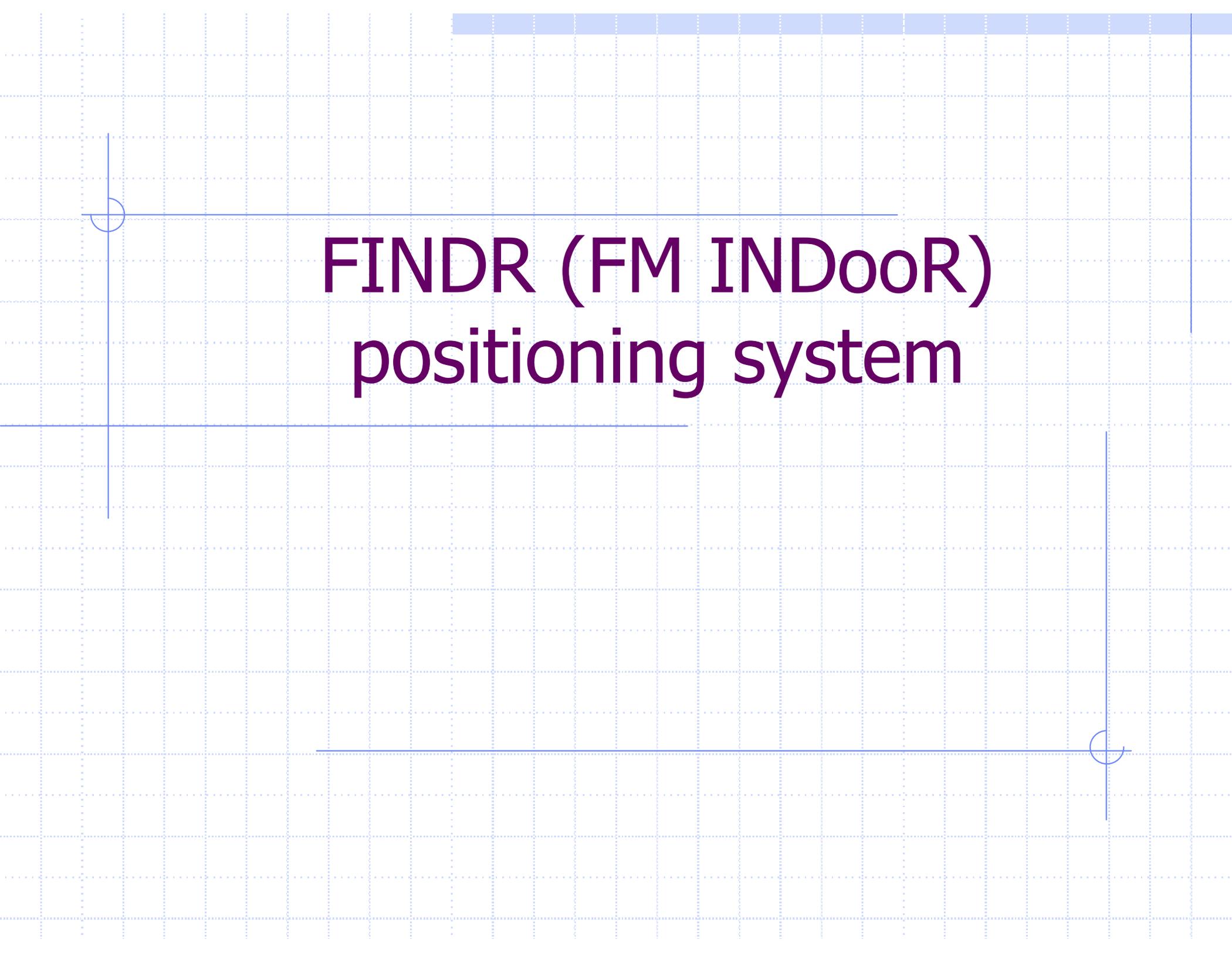


Introduction

- ◆ Location-based services are growing
 - Navigation
 - Context-aware applications
 - Behaviour patterns detection
- ◆ GPS is for outdoors only
- ◆ Indoor positioning technologies:
 - Wi-Fi, UWB, infrared, ultrasound, WSN...
 - Expensive and/or specialised hardware
 - FM is cheap and available

Related work

- ◆ FM positioning was first introduced by John Krumm et al.
 - Based on FM broadcast stations
 - Custom receiver (SPOT watch)
 - They were able to distinguish 6 districts of Seattle (several kilometers apart) with ~80% accuracy



FINDR (FM INDOOR) positioning system



FINDR: why FM?

◆ Price

- An FM transmitter is about 3-10 times cheaper than a Wi-Fi access point

◆ Privacy

- Zero-emission client device (FM receiver)

◆ Availability

- FM transmitters and receivers are easily available from consumer electronics shops

◆ Power consumption

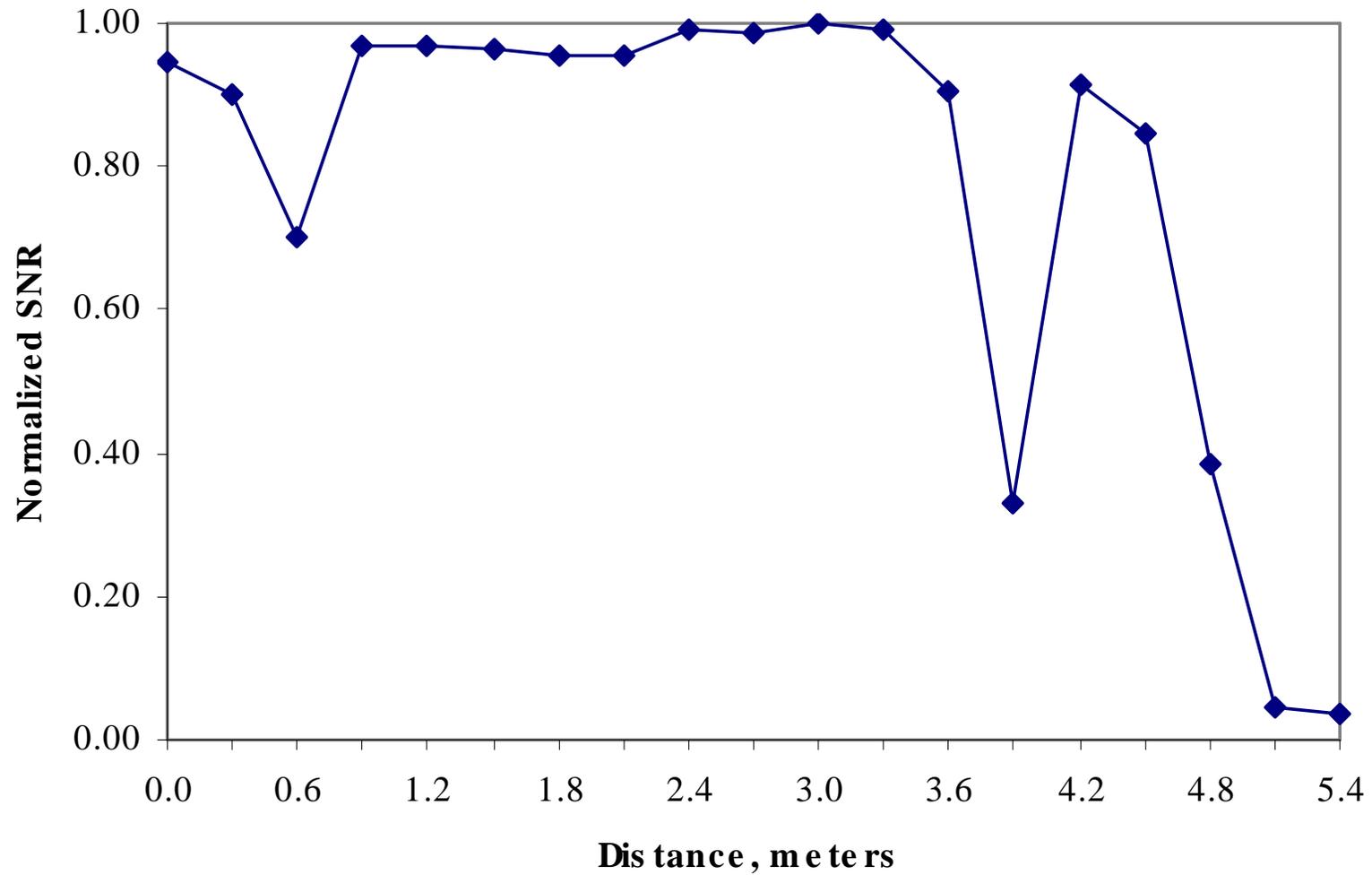
- Wi-Fi (listening mode) – 300 mW
- FM receiver – 15 mW

FINDR: how to

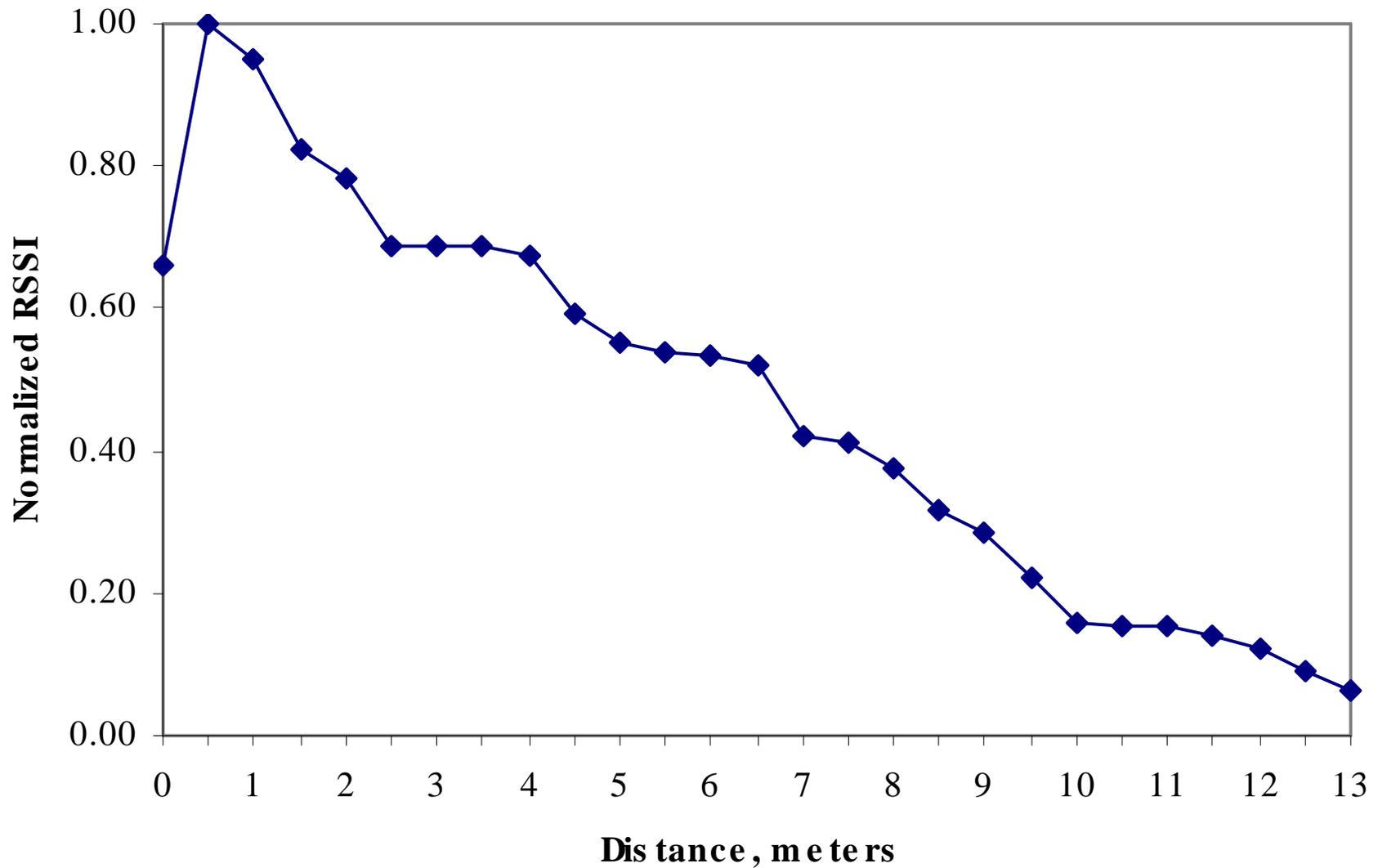
Distance-dependent features:

- ◆ Signal-to-noise ratio
- ◆ Received signal strength
- ◆ Stereo channel separation (future work)

Signal-to-noise ratio



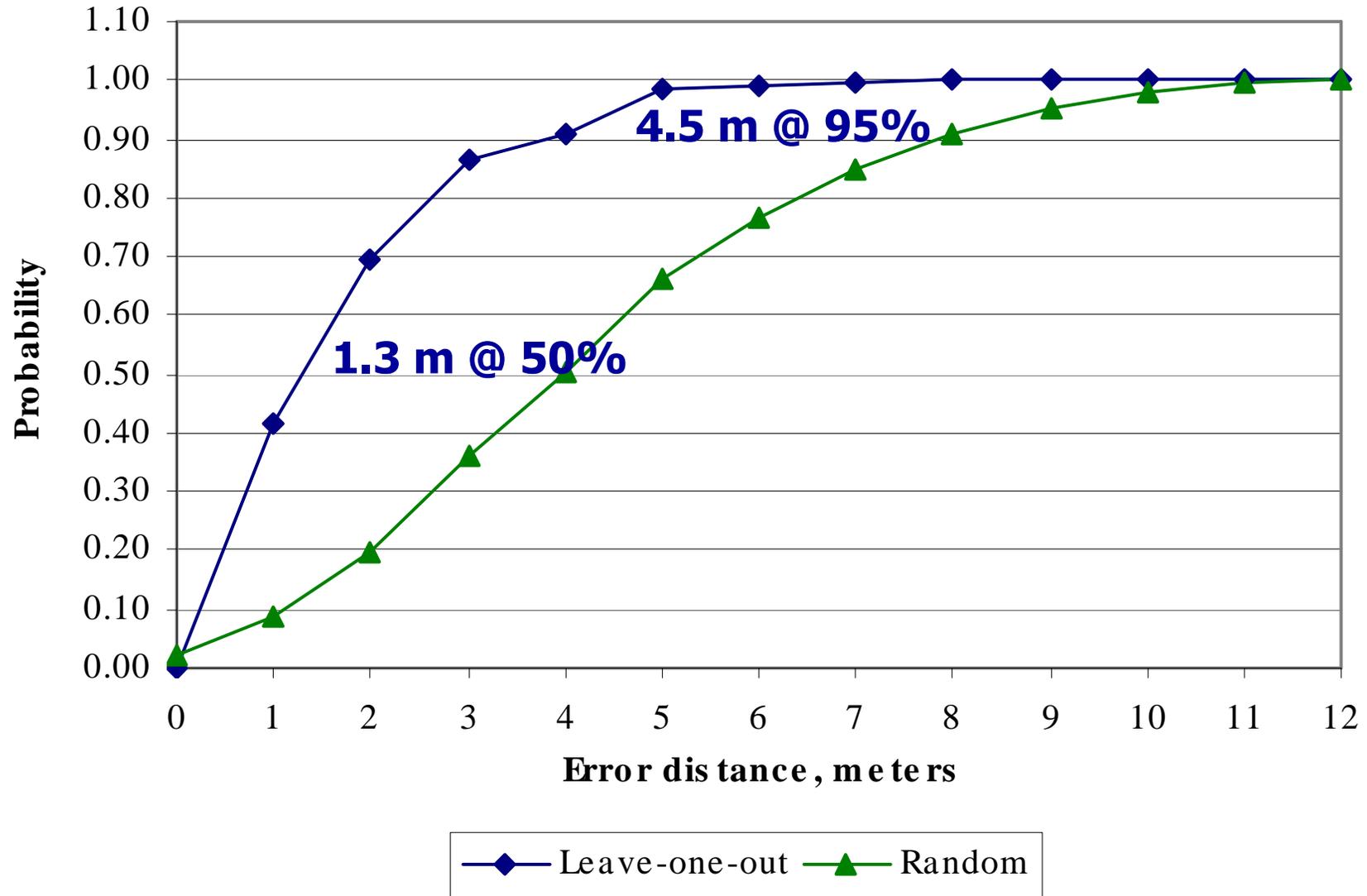
Received signal strength



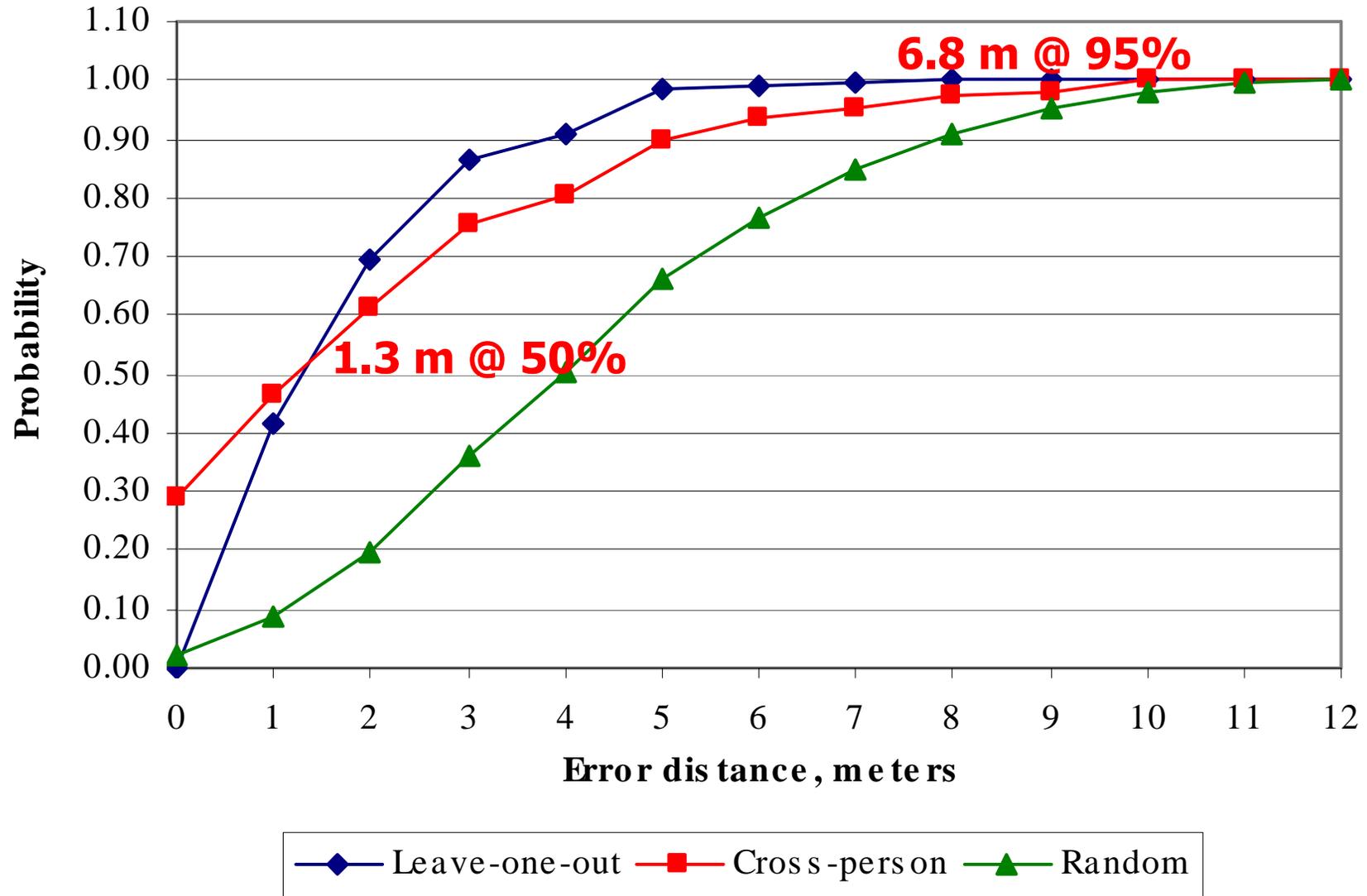
FINDR: evaluation

- ◆ 12 x 6 m office with standard furniture
- ◆ 3 FM transmitters with extended antennas, tuned to broadcast-free frequencies
- ◆ Nokia N800 tablet as the client device
- ◆ K-Nearest Neighbour (kNN) classifier
- ◆ Two datasets collected by different people

FINDR: accuracy



FINDR: accuracy



Summary

- ◆ Hardware cost < 100 euro
- ◆ Easily available components
- ◆ Accuracy favourably comparable to Wi-Fi
 - 1.3 m @ 50% confidence (RADAR: 2.9 m)
 - 4.5 m @ 95% confidence (RADAR: ~14 m)
- ◆ Future work: Experimental comparison with Wi-Fi in the same environment



Thank you!