



Tuning to your position

FM radio based indoor localization
with spontaneous recalibration

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Indoor localization

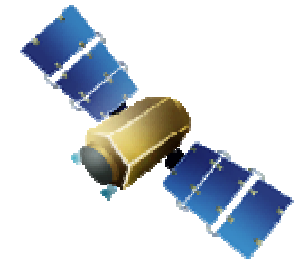
- Activity recognition
- Behavior prediction
- Object tracking
- Health care





Indoor localization

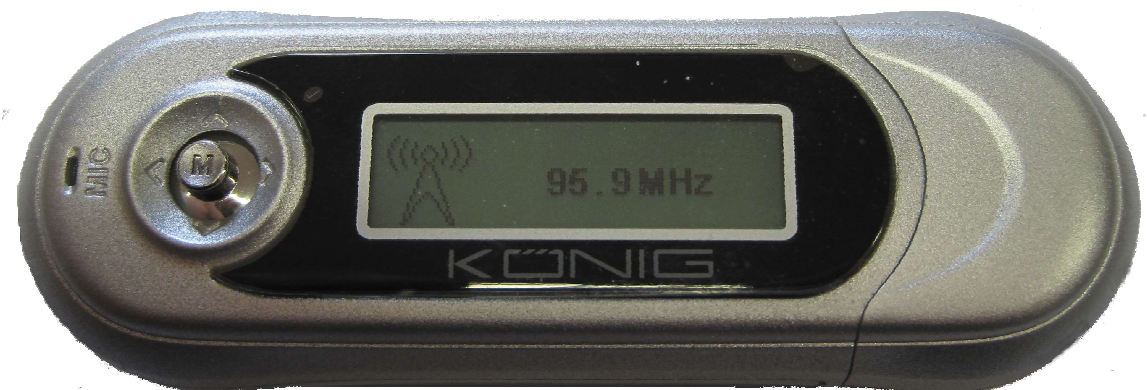
- GPS does not work indoors
- Specialized systems are expensive (e.g. UbiSense)
- Wi-Fi is the de-facto standard, but
 - The coverage is limited
 - It can be prohibited in sensitive environments





FM transmitters

- Transmitters are available off the shelf
- Cost-effective (10–20 euro)
- No license required



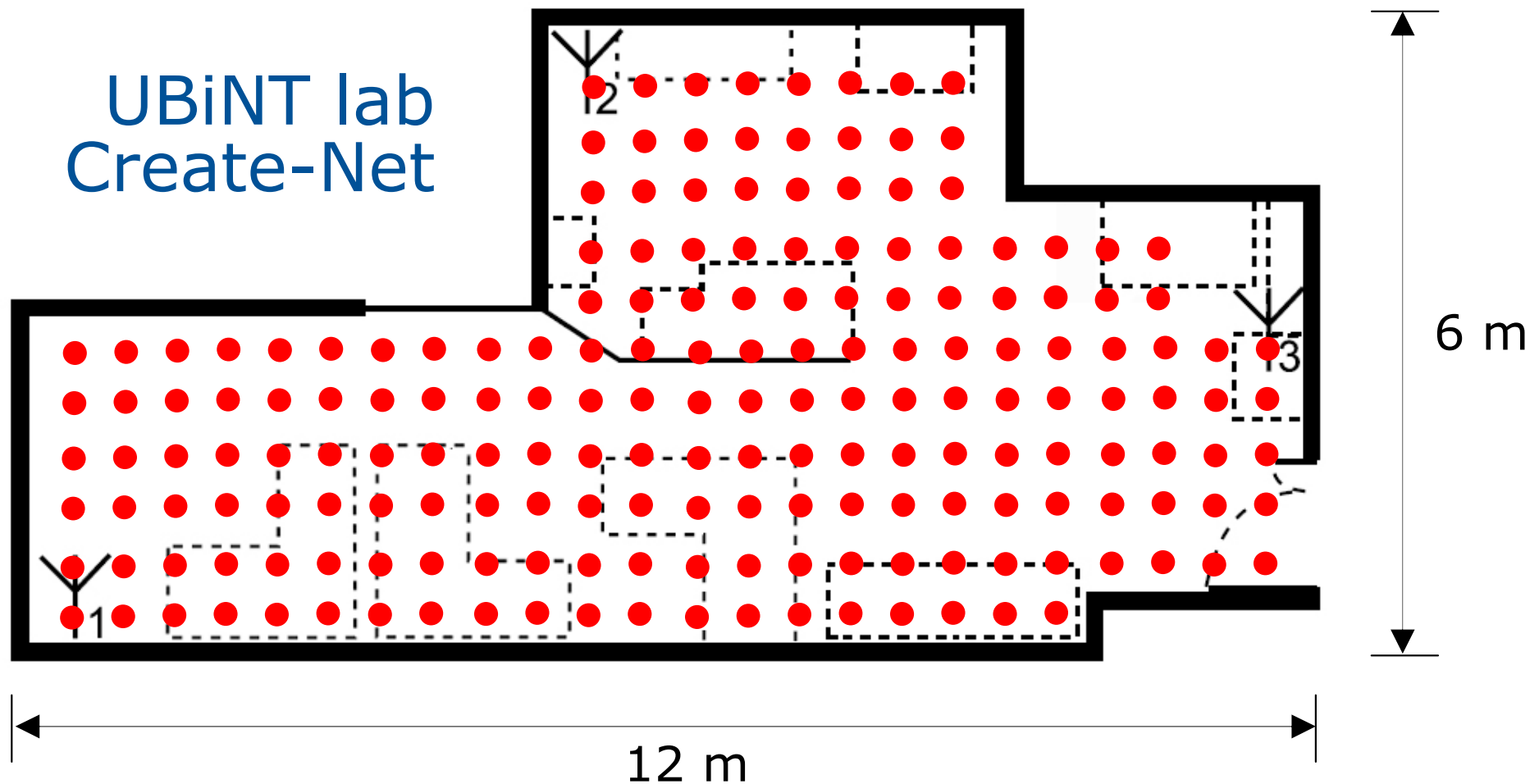


Potential client devices



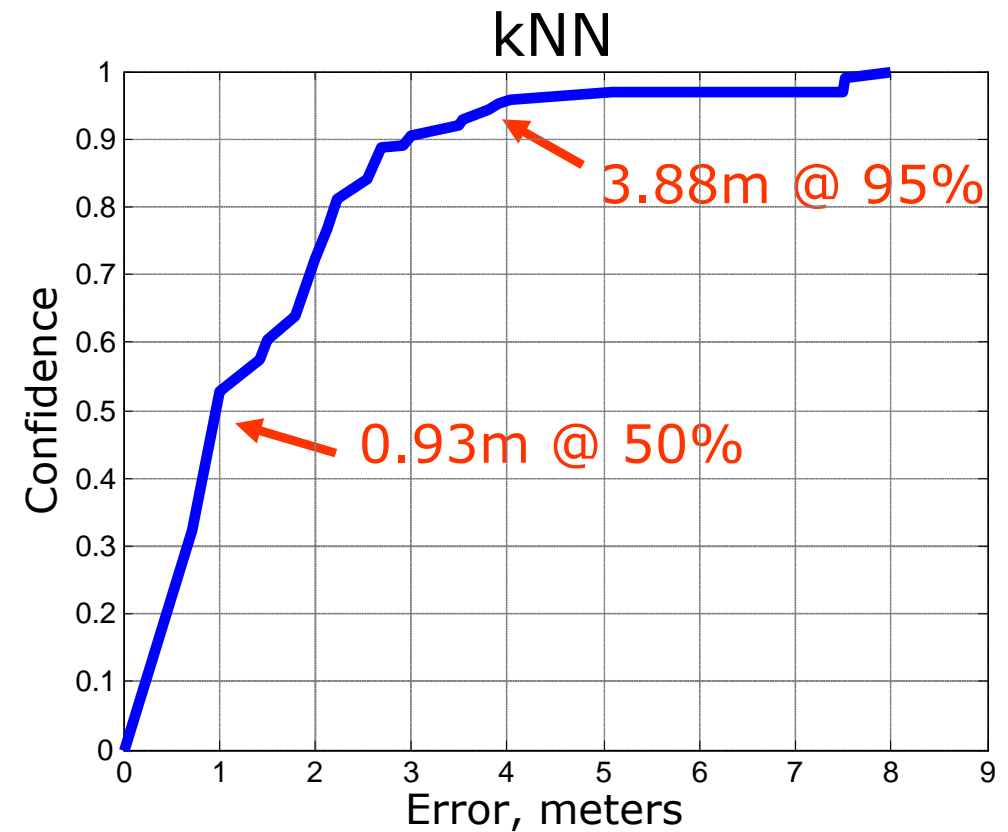
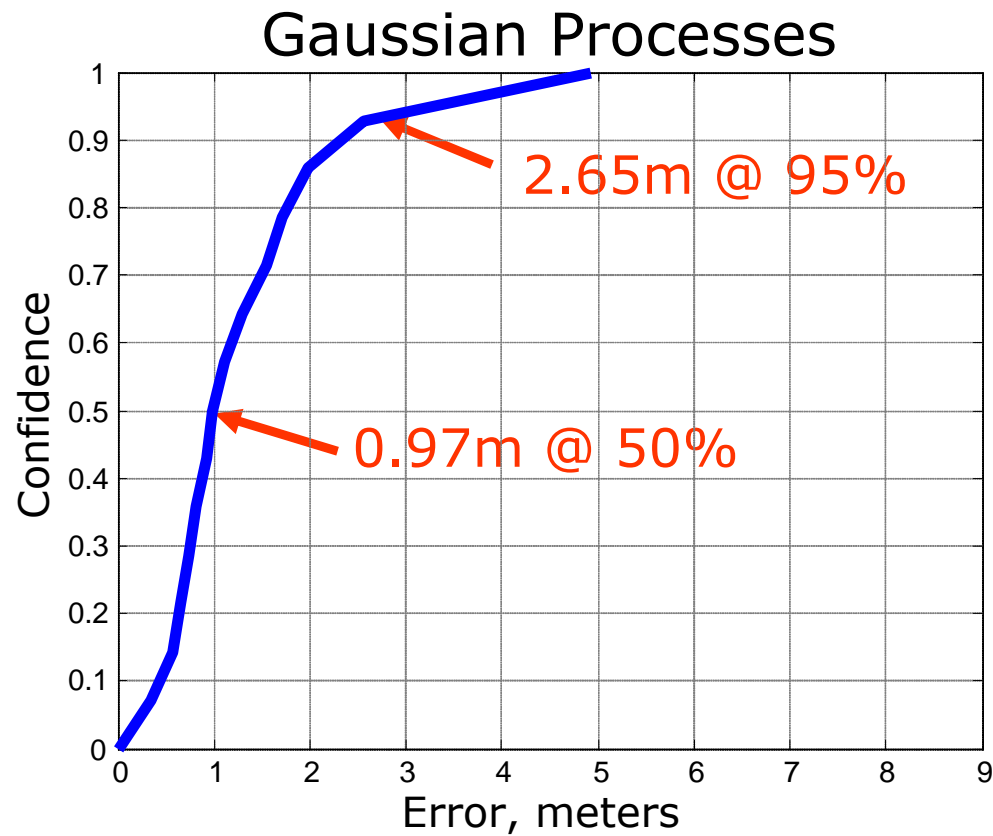


Experiment setup





FM positioning accuracy





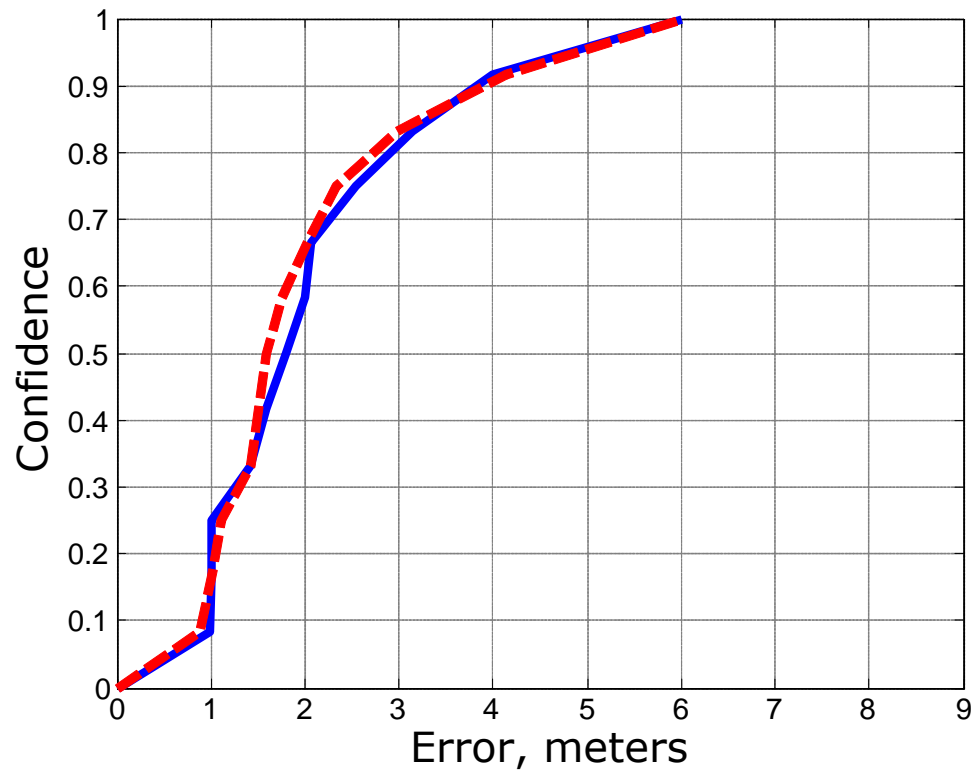
FM versus...



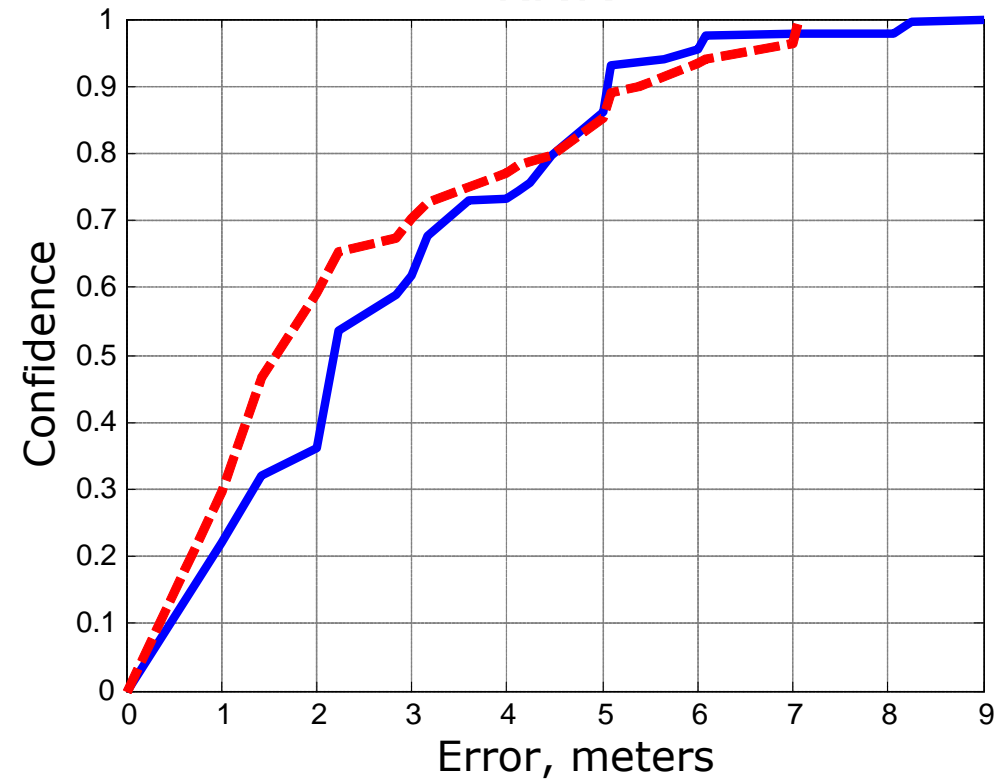


FM versus Wi-Fi

Gaussian Processes



kNN



--- FM

— Wi-Fi



Wi-Fi: 300 mW
FM: 15 mW



€ 50–100



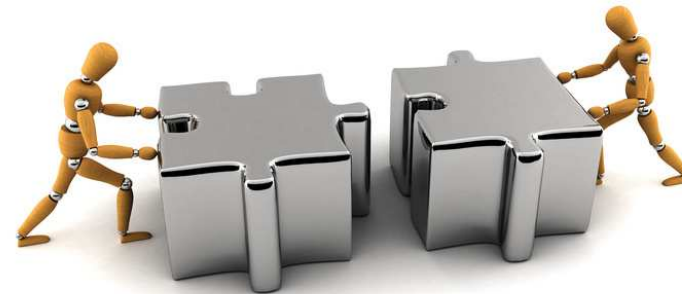
€ 10–20





FM with Wi-Fi

- Combined coverage
- Longer battery life



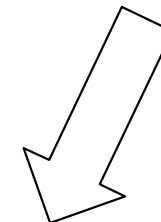
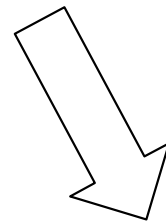
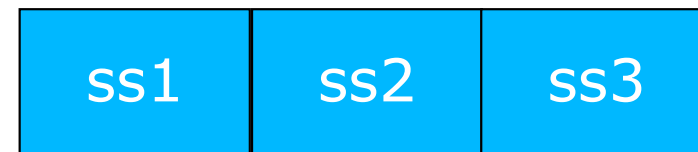


FM with Wi-Fi

FM fingerprint



Wi-Fi fingerprint



Combined wide fingerprint



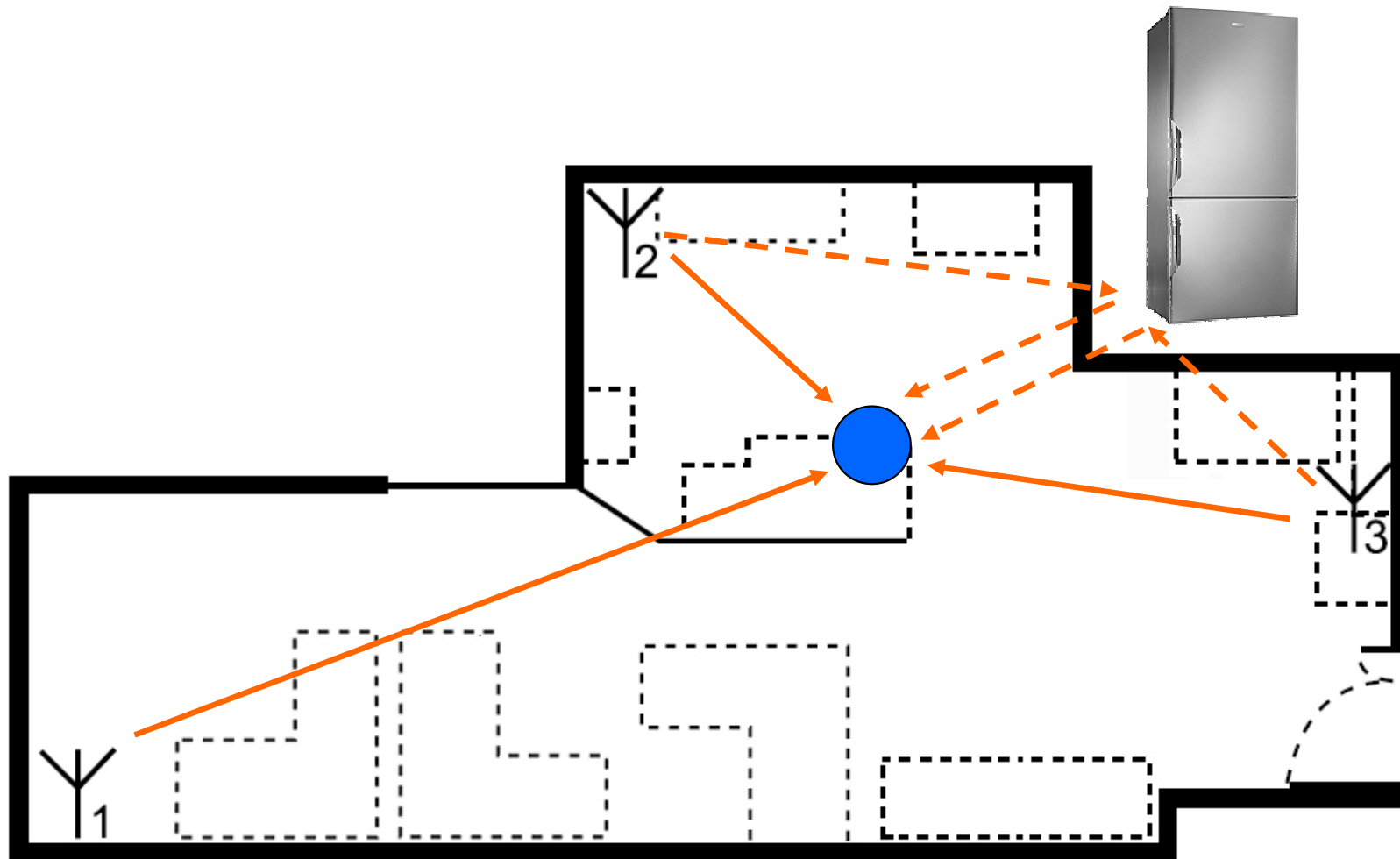
FM with Wi-Fi

- Combined coverage
- Longer battery life
- Improved accuracy (by up to 22%)





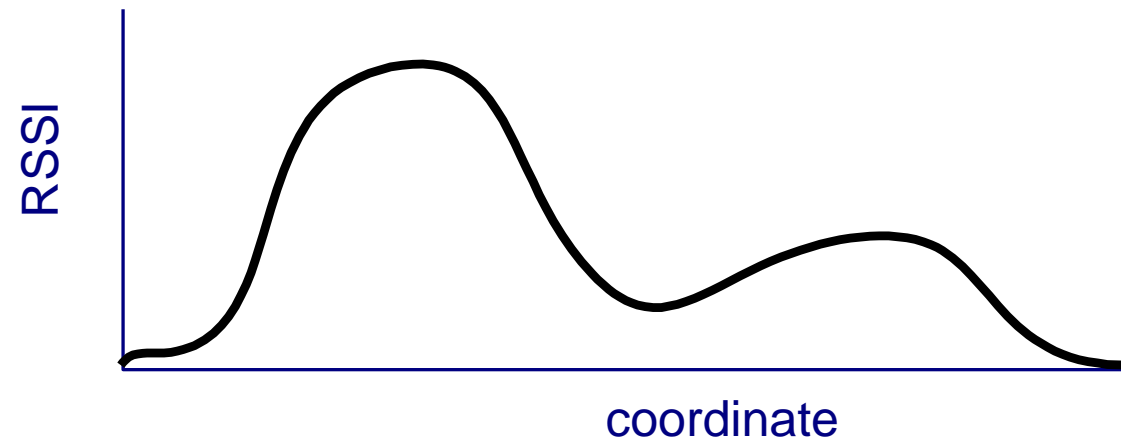
What if...



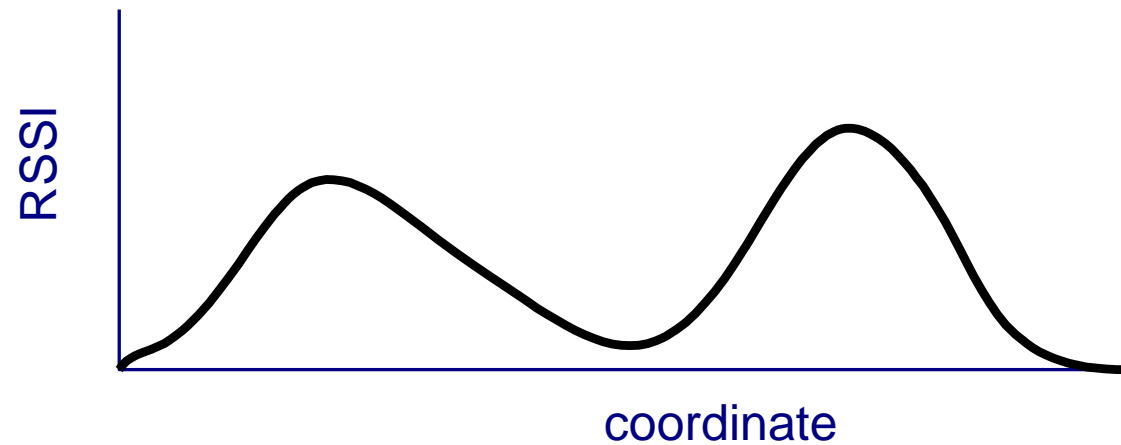


Signal strength distribution

Before:



Now:





Accuracy degradation

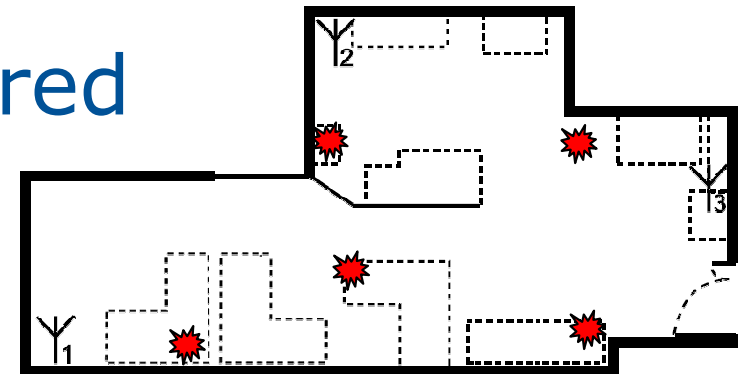
- Caused by:
 - Changes of furniture layout
 - Components ageing
- Solution: periodic recalibration
 - Requires trained personnel
 - Tedious and expensive





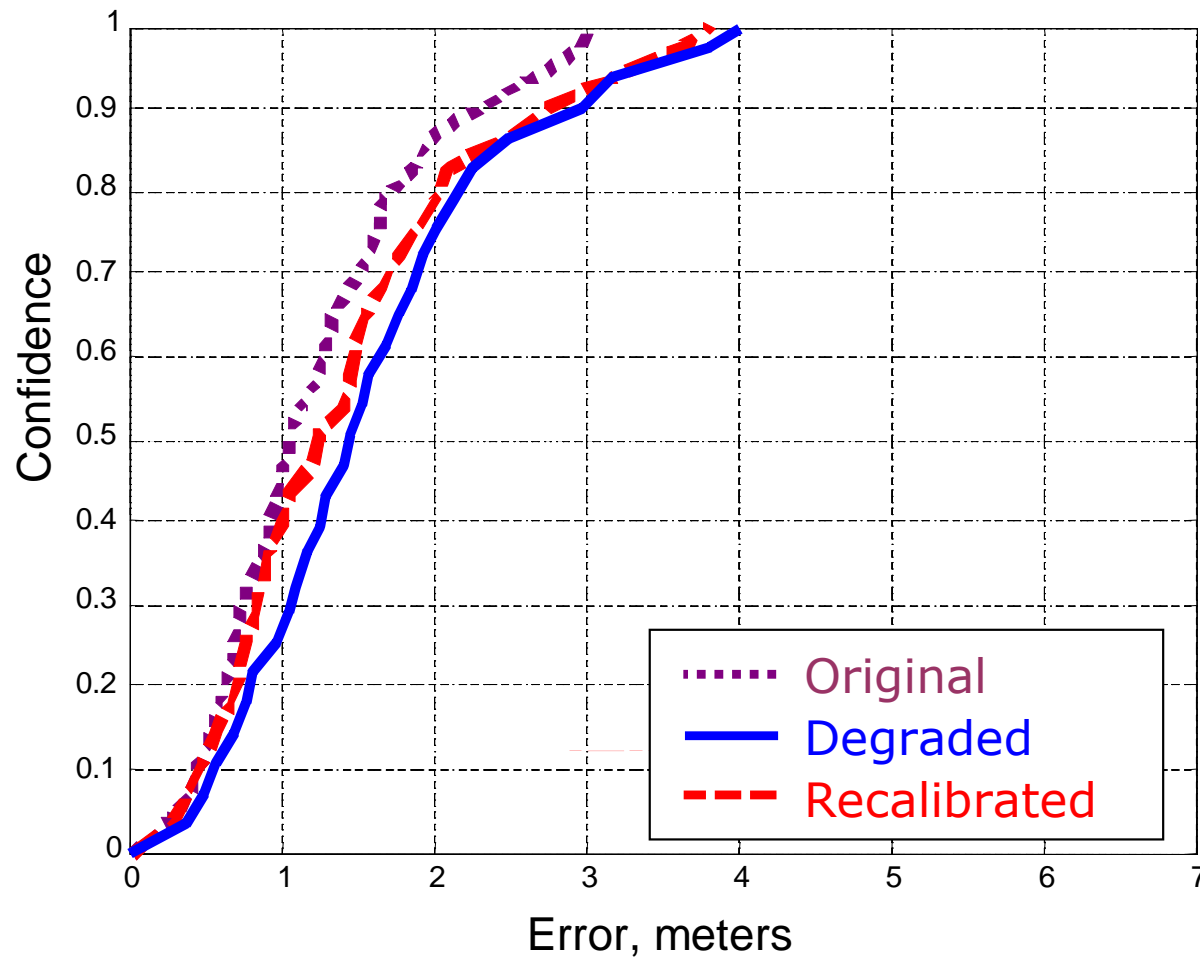
Spontaneous recalibration

- Recalibration performed automatically when the device position is known.
 - In a cradle
 - On a nightstand
 - Connected to a wall charger
- No additional hardware required
- Transparent for the user





Effect of recalibration





Summary

- Cheap and efficient indoor positioning system
- FM localization is as accurate as Wi-Fi
- The accuracy can be maintained automatically



Thank you!

Questions?

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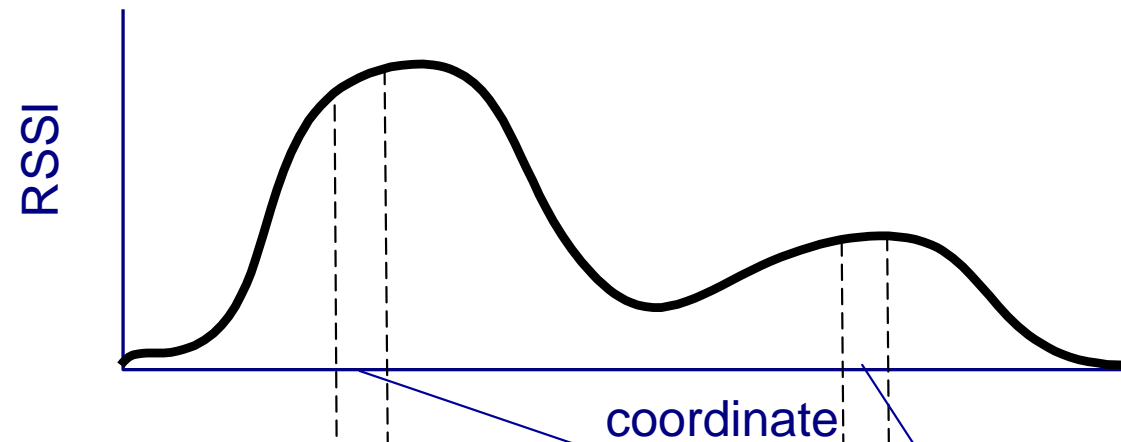
Signal strength representation

FM	Wi-Fi	Unified (dB)
40..50	"Excellent"	-50
30..39	"Very good"	-60
20..29	"Good"	-70
10..19	"Low"	-80
1..9	"Very low"	-90
0	"No signal"	0

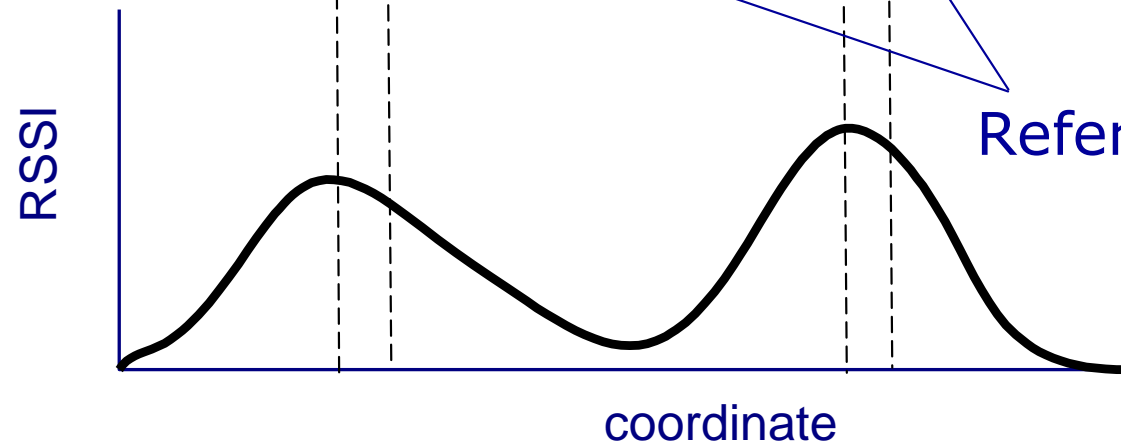


Spontaneous recalibration

Before:



Now:



Reference positions



Spontaneous recalibration

