

# Node Positioning in a Limited Resource Wireless Network

**IWES 2007** 6th International Workshop on Ambient Intelligence & Embedded Systems 6-7 September, 2007, Vaasa, Finland



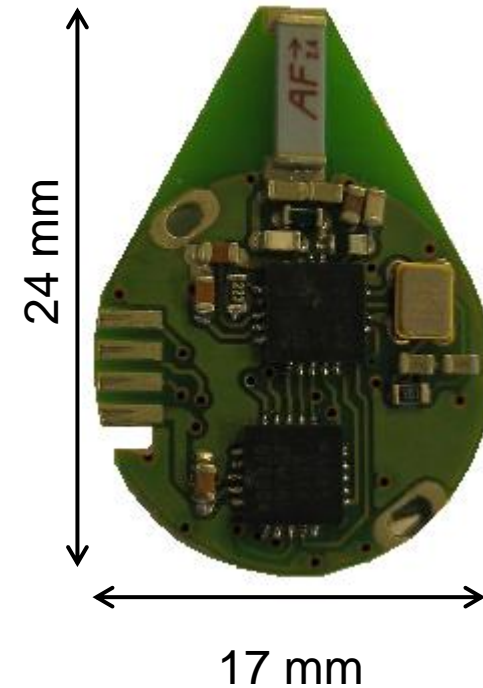
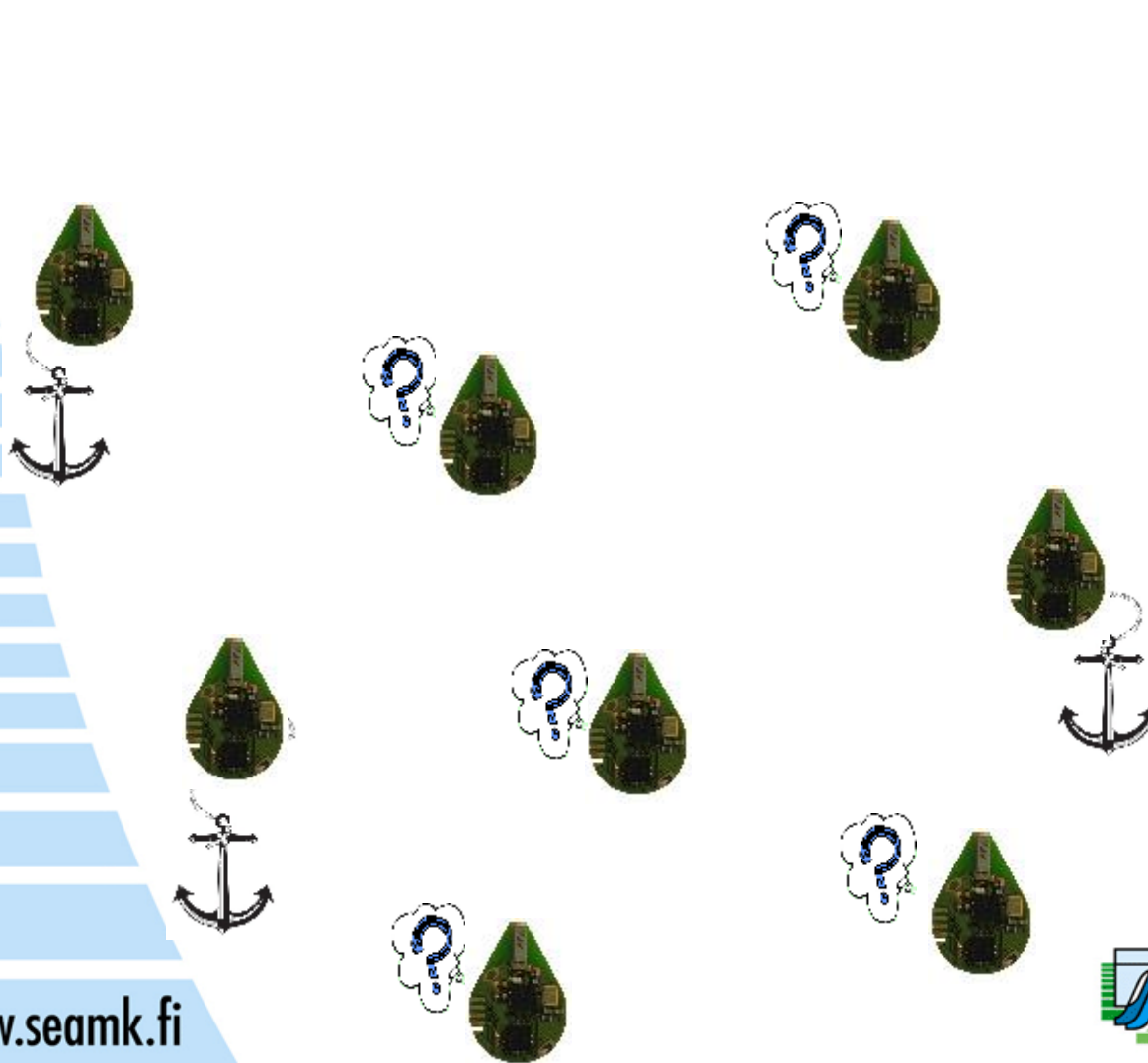
SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES  
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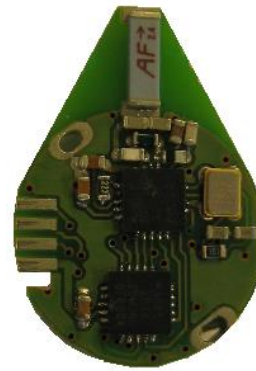
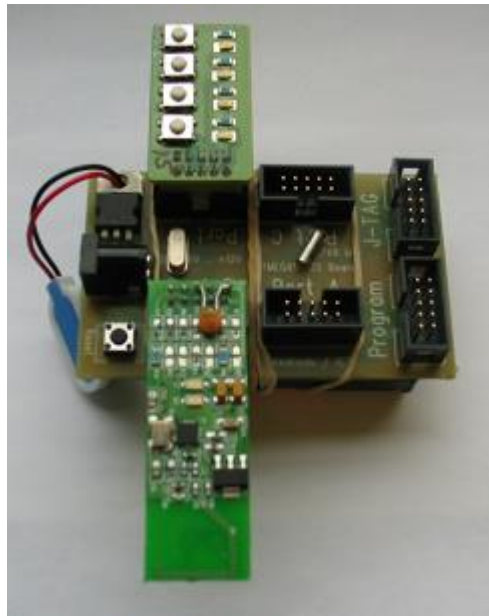
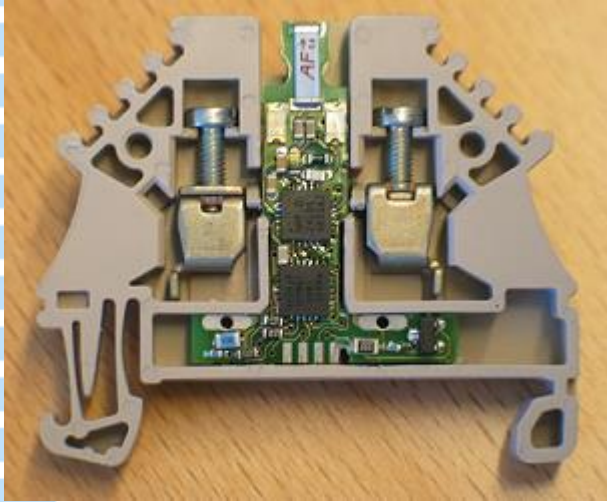
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# Node Positioning in a Limited Resource Wireless Network



# Applications



# Existing possibilities

Bluetooth

GPS

Angle measuring

Control unit

ZigBee

Signal power measuring

RFID

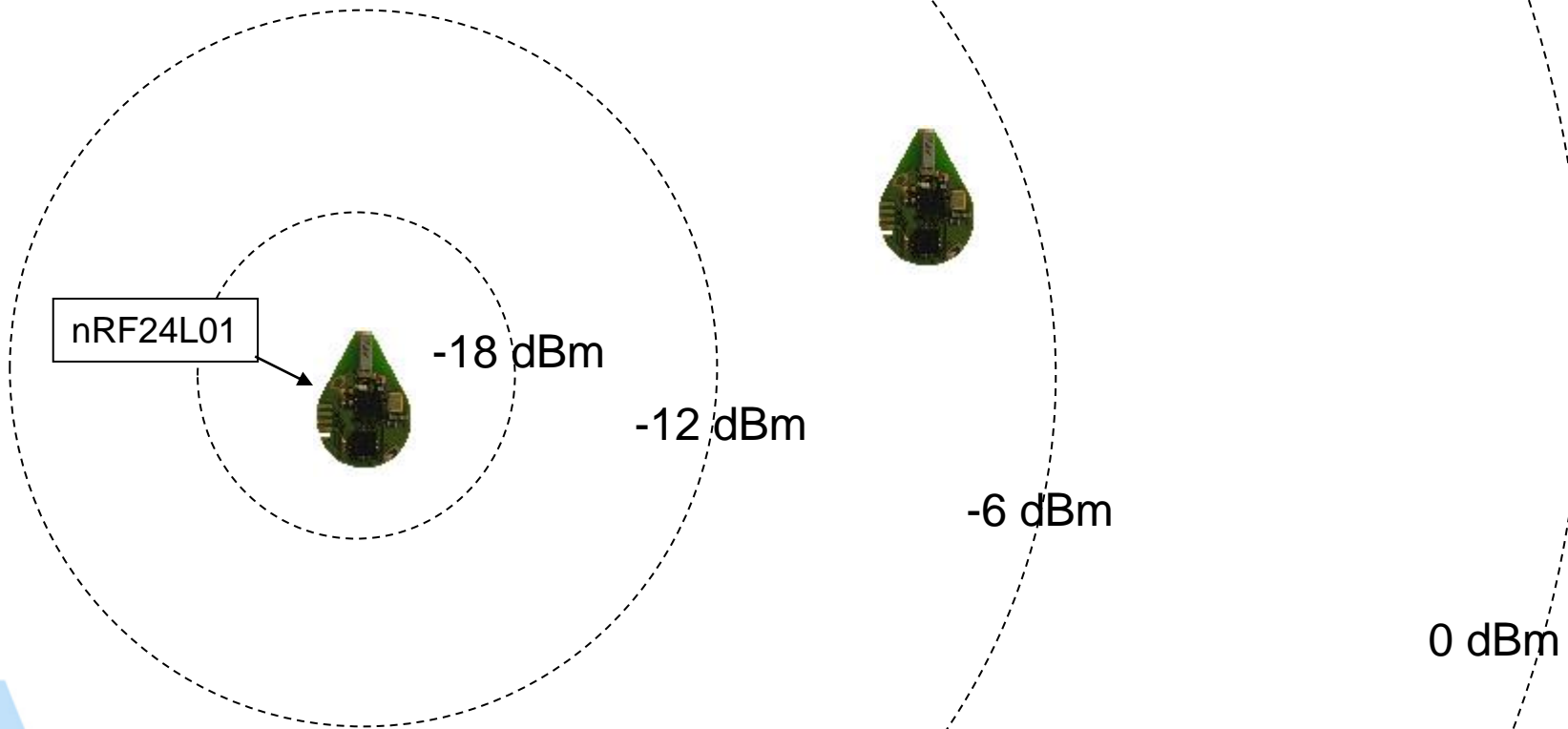
Computing

Time-of-arrival measuring

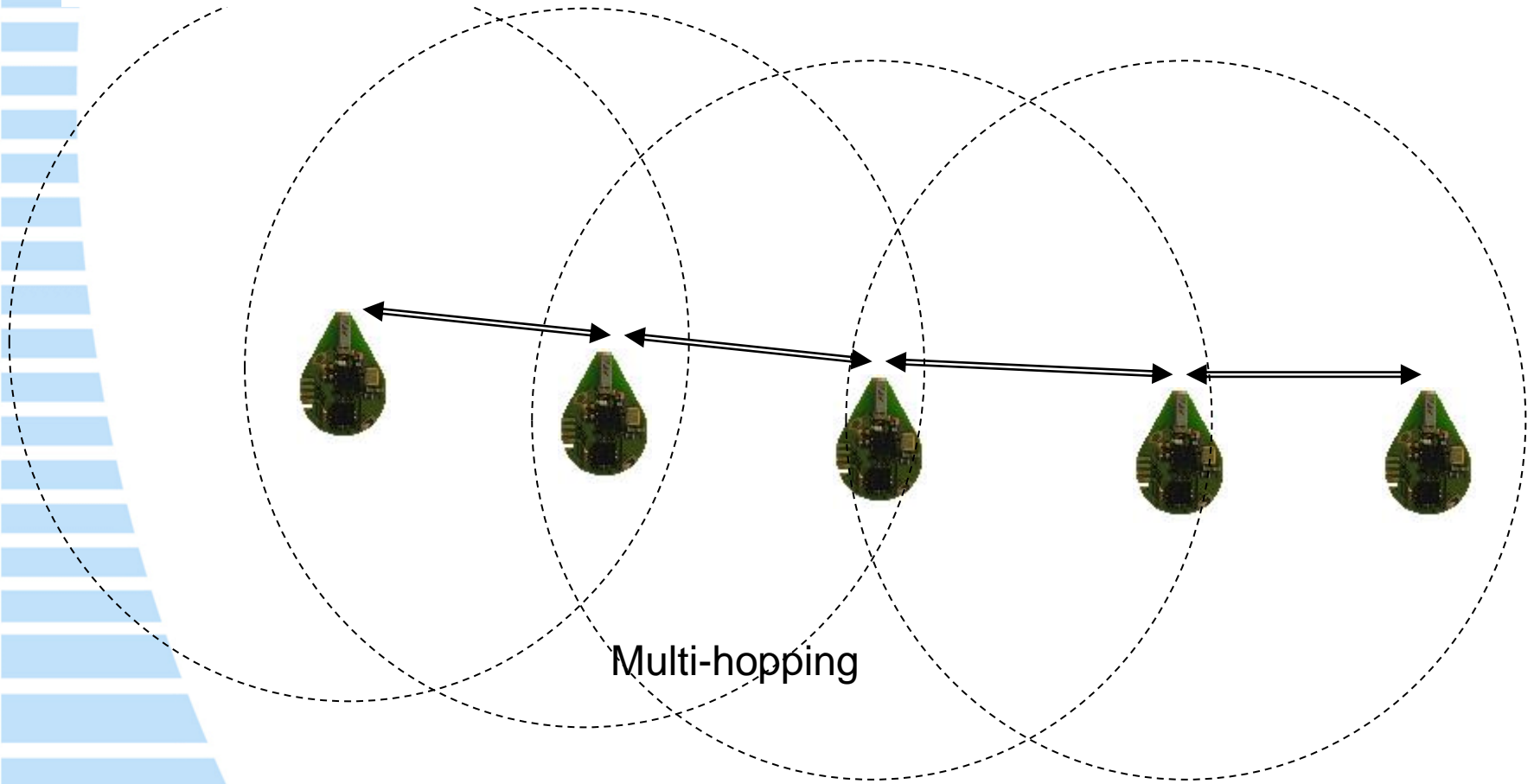
Anchor beacons

Limited resource ?

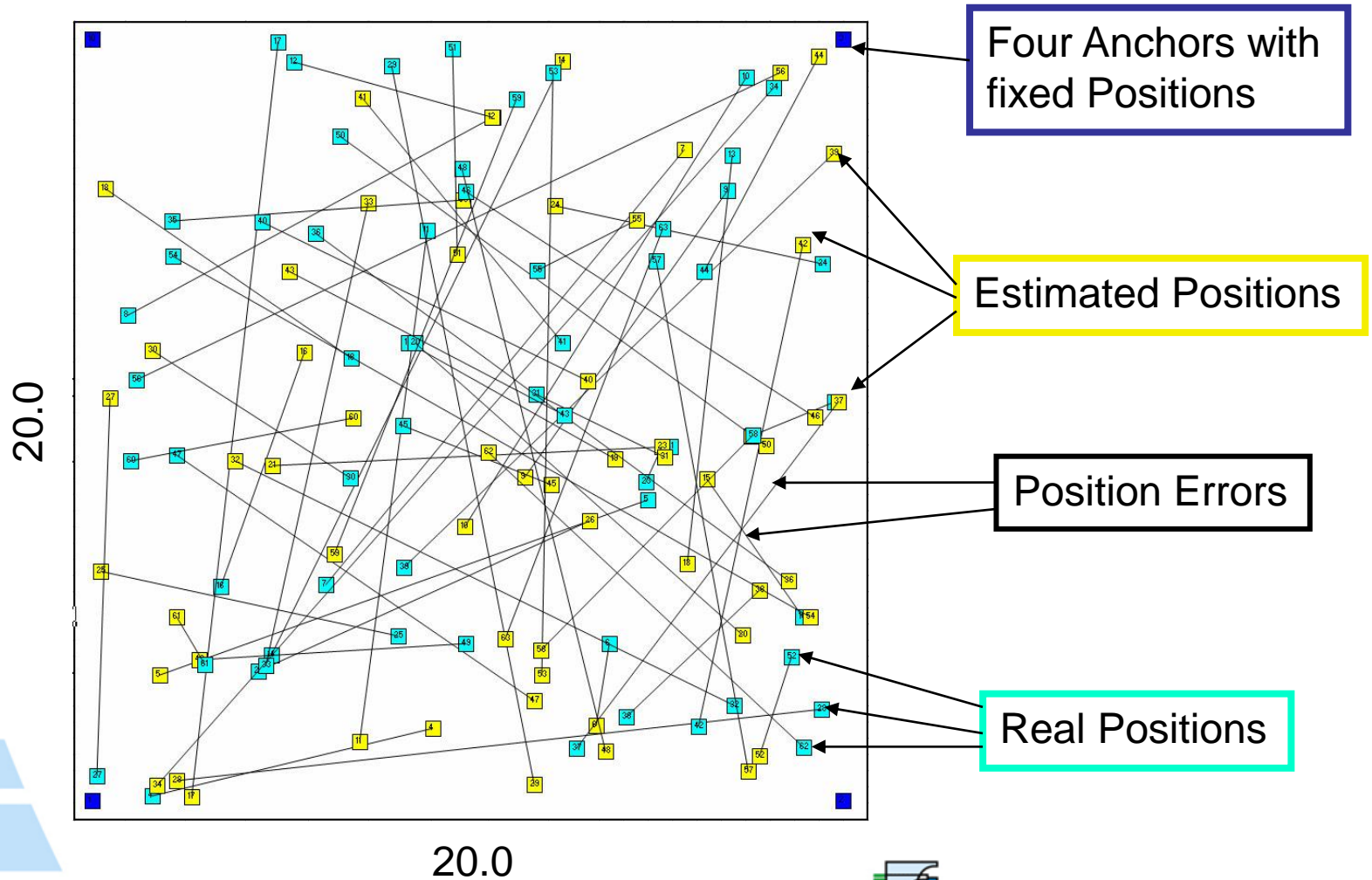
# Distance measuring: RF-power



# Distance measuring: Multi-hopping



# The start state of the simulation



# Mean value positioning



(X1, Y1)



(X2, Y2)



(X3, Y3)

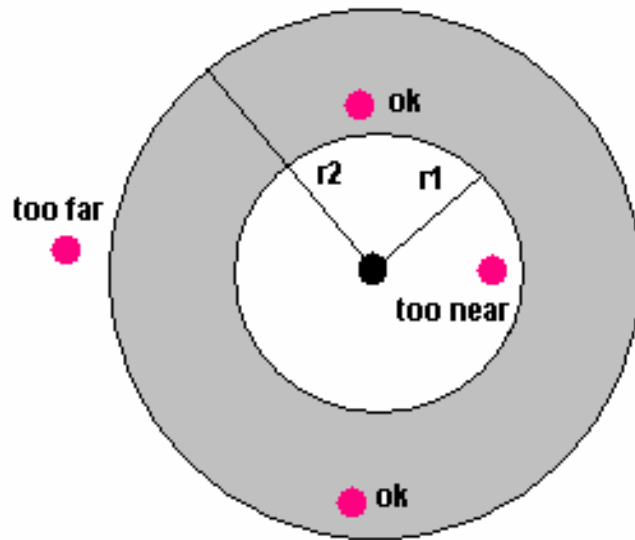
$$X = \frac{\sum X_n}{n}$$

$$Y = \frac{\sum Y_n}{n}$$

If distance is measured,  
the mean value is  
weighted by distance



# Iterative, Passive Position correction

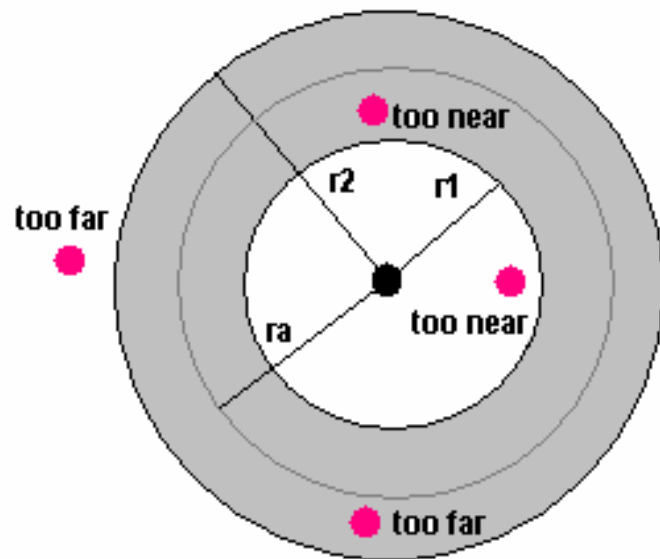


● Measured, real distance

● Estimated distance

If the Neighbour is too far or too near, correct own estimated position

# Iterative, Active Position correction

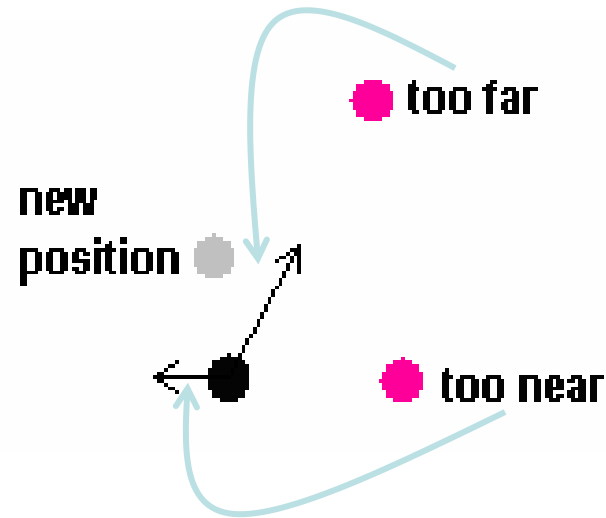


- Measured, real distance
- Estimated distance

If the Neighbour is too far or too near, correct own estimated position

$$r_a = \sqrt{\frac{r_2^2 - r_1^2}{2}}$$

# Iterative correction

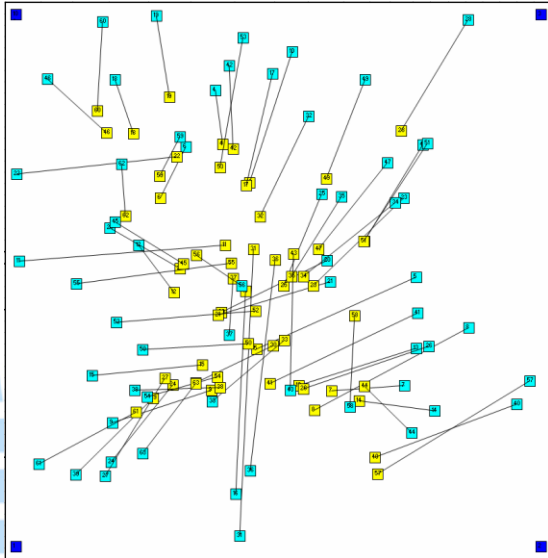


Do with all neighbours:  
read the estimated position and multi-hops of neighbour  
if neighbour is too far,  
    move own estimated position nearer  
if neighbour is too near,  
    move own estimated position farther

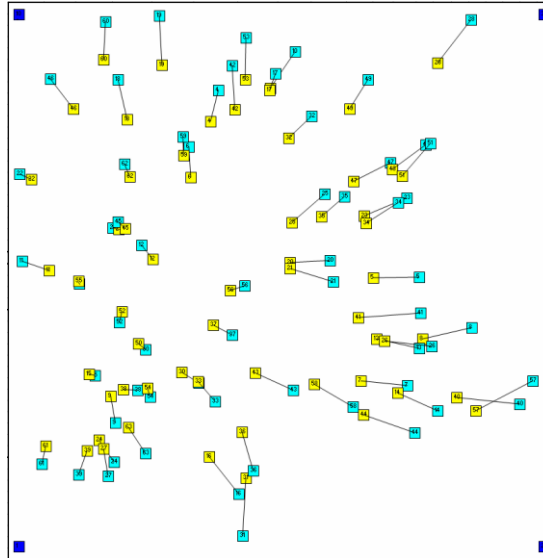
# Positioning methods

1. Mean value
  2. Mean value in four sectors
  3. Iterative passive positioning
  4. Iterative active positioning
- Multihop distance measuring with 1-4 steps
  - Fixed or mobile nodes
  - Neighbours within distances 5, 8, 11 or 14

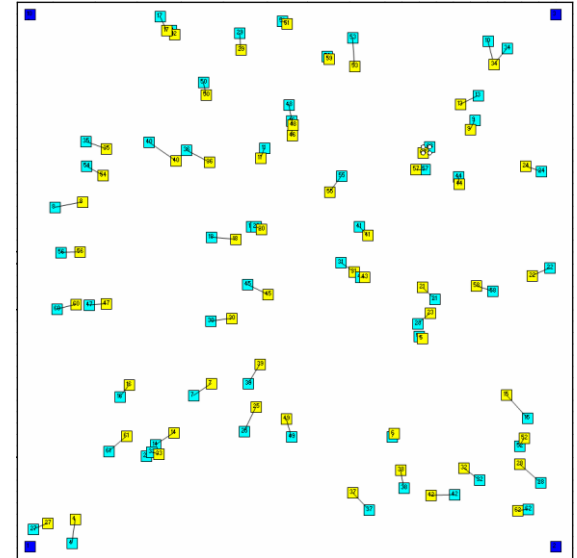
# Positioning quality



MSDE = 22

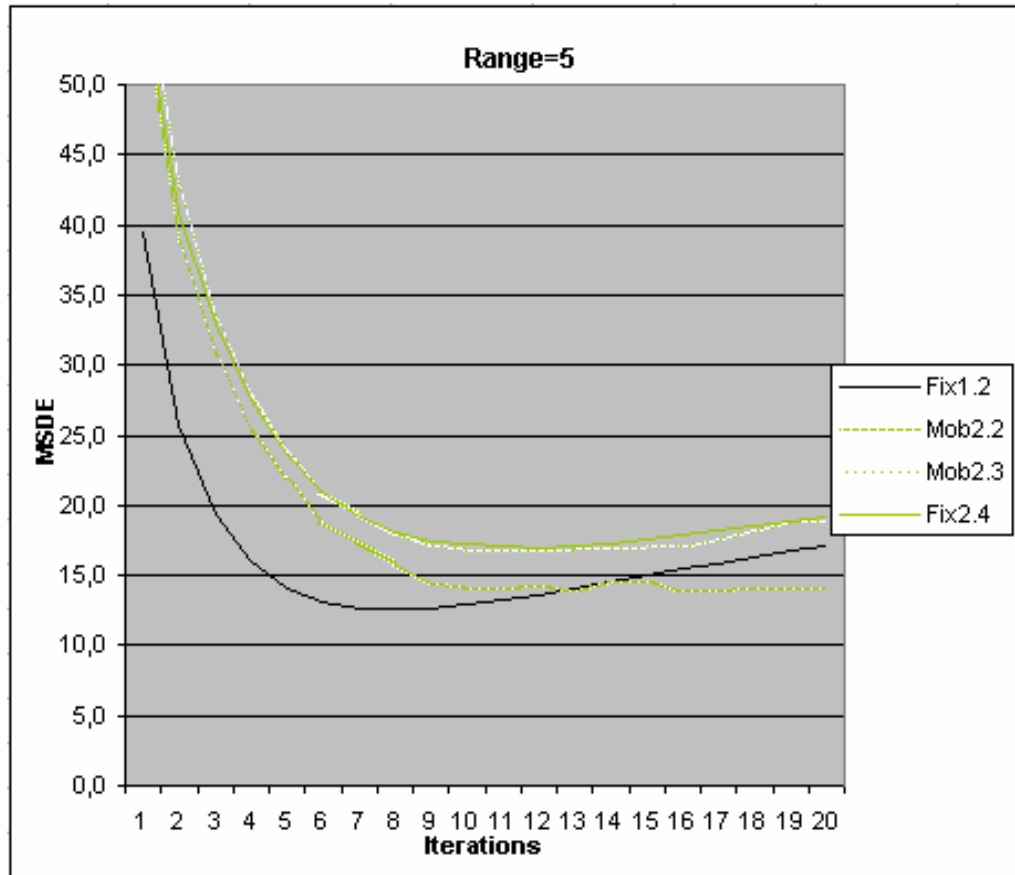


MSDE = 4.0

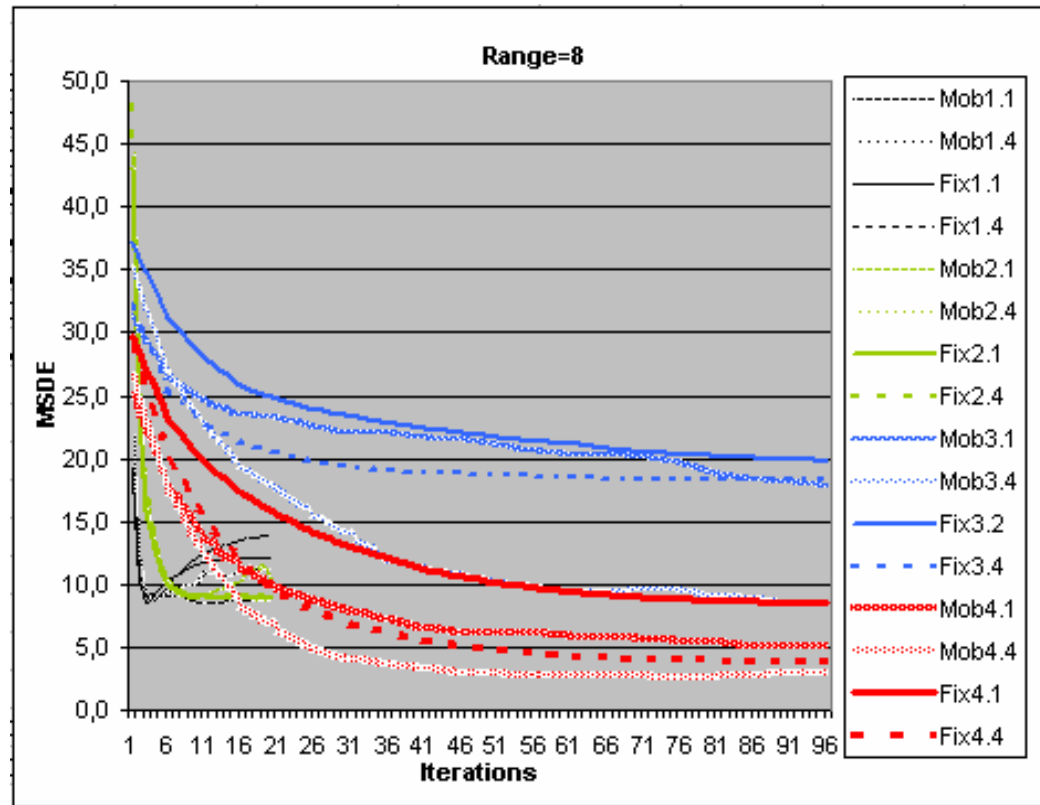


MSDE = 2,6

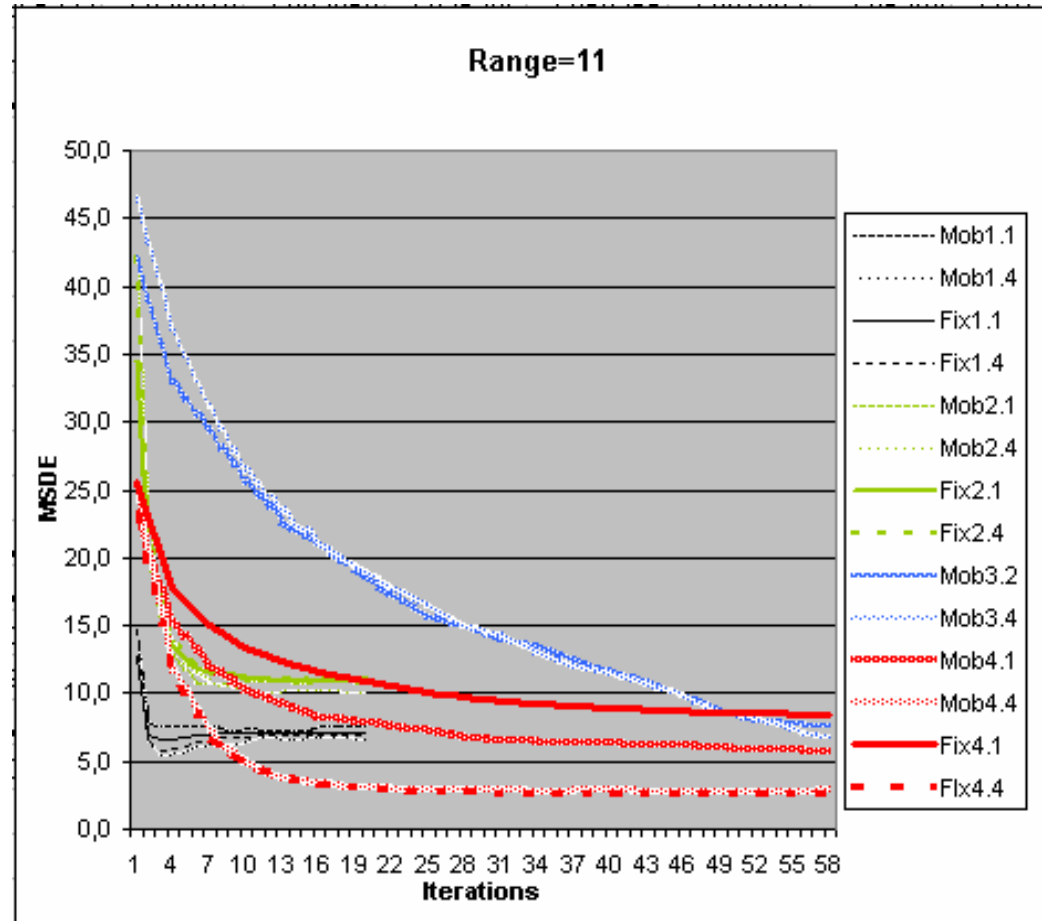
# Positioning using range 5 (~ 6 neighbours)



# Positioning using range 8 (~14 neighbours)

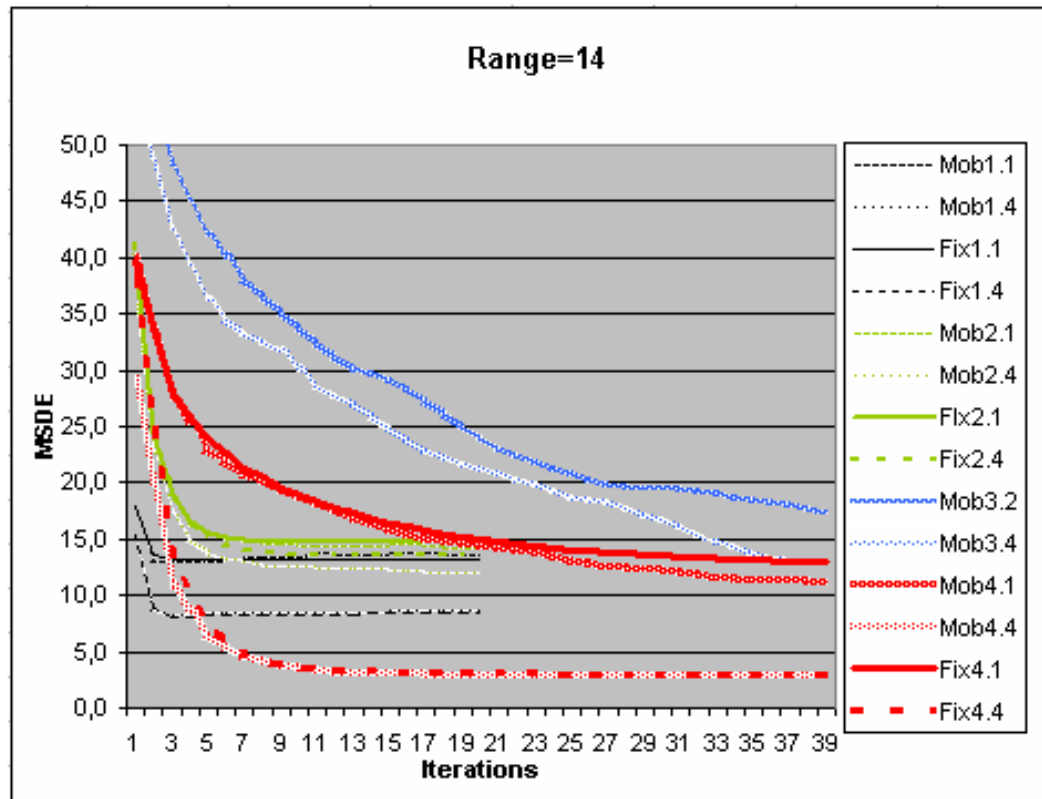


# Positioning using range 11 (~22 neighbours)

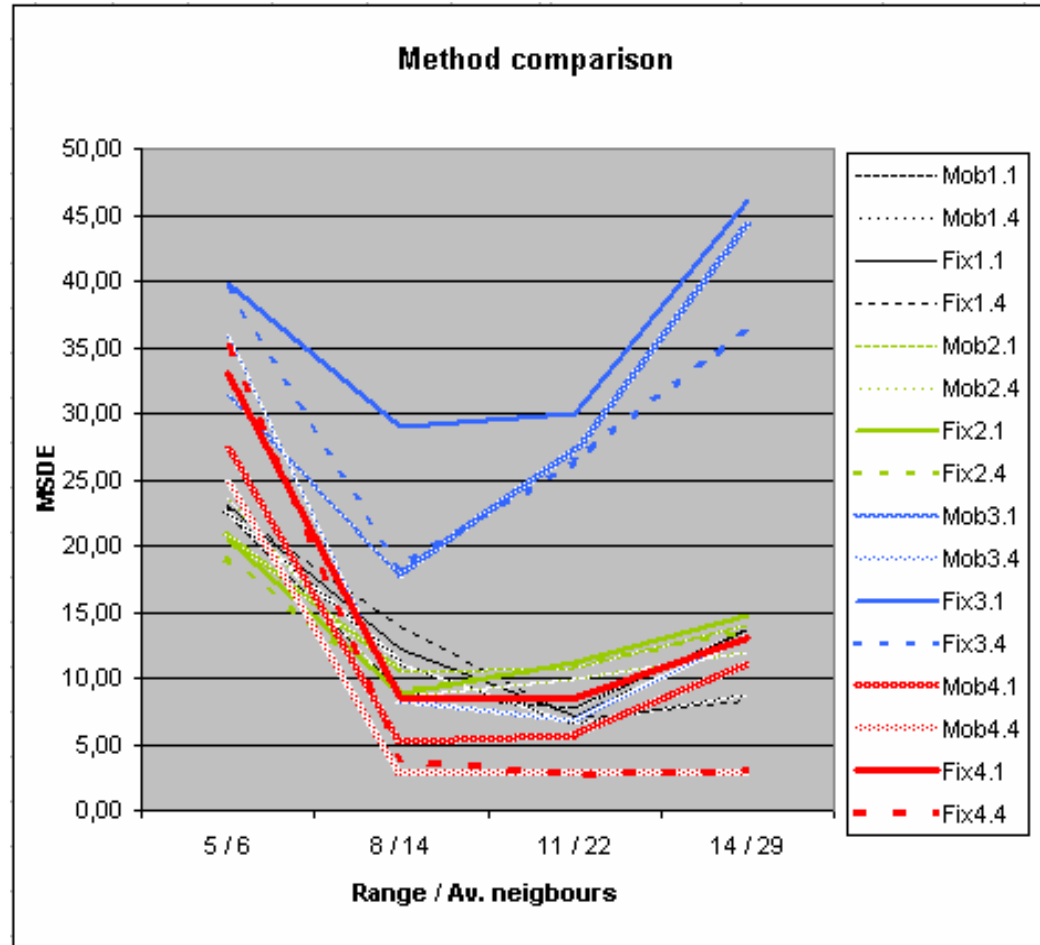




# Positioning using range 14 (~29 neighbours)



# Comparing methods

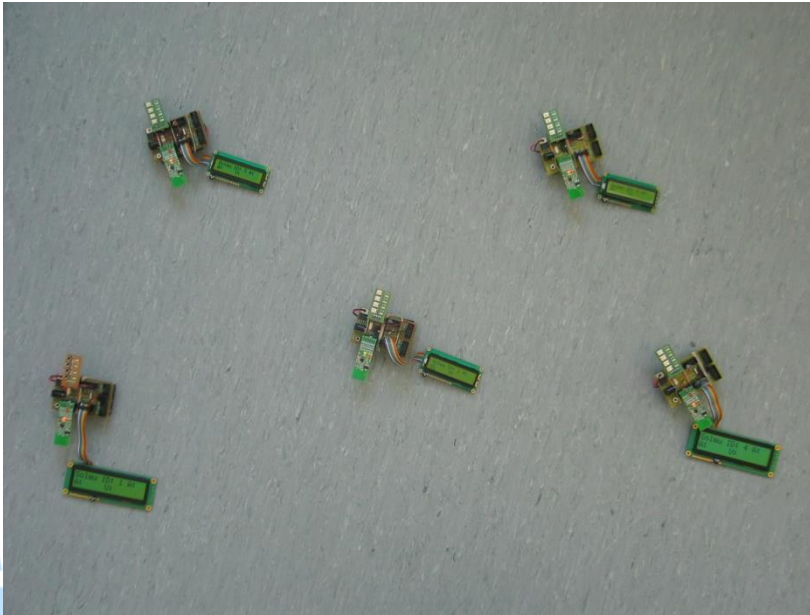


Children

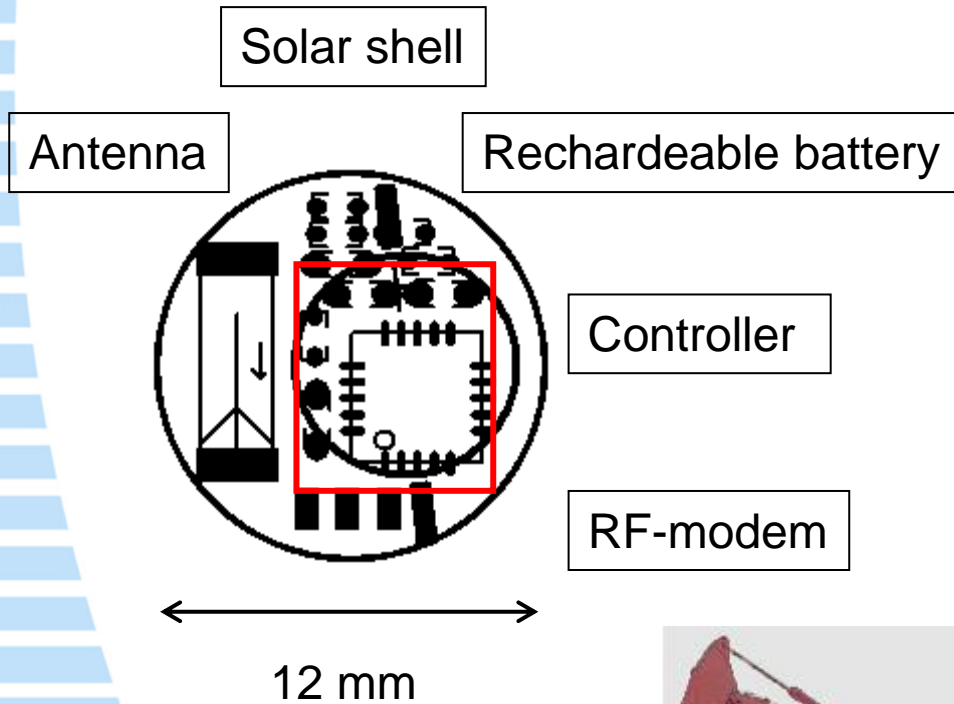
Animals

Sensor Networks

# Testing



# Future: distributed intelligence



# Thank you !

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