Ubiquitous inference of mobility state of human custodian in people-centric context sensing

Wac, Katarzyna; Gustarini, Mattia

Ubiquitous Inference of Mobility State of Human Custodian in People-Centric Context Sensing

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QoL

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Department of Management Studies

UNIVERSITÉ DE GENÈVE

Motivation

- Some people-centric sensing challenges
  - capture of person's mobility
  - understanding of context changes
  - preservation of user privacy

Goal

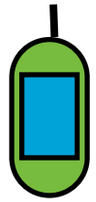
- Infer **mobile-fixed context** of the *human custodian*
  - accurately and efficiently (battery)
  - enable *dynamic* changes of the sensors' duty cycle length

Mobility Sensor

Raw Data Collection

Mobility Sensor

Raw Data Collection



Mobility Sensor

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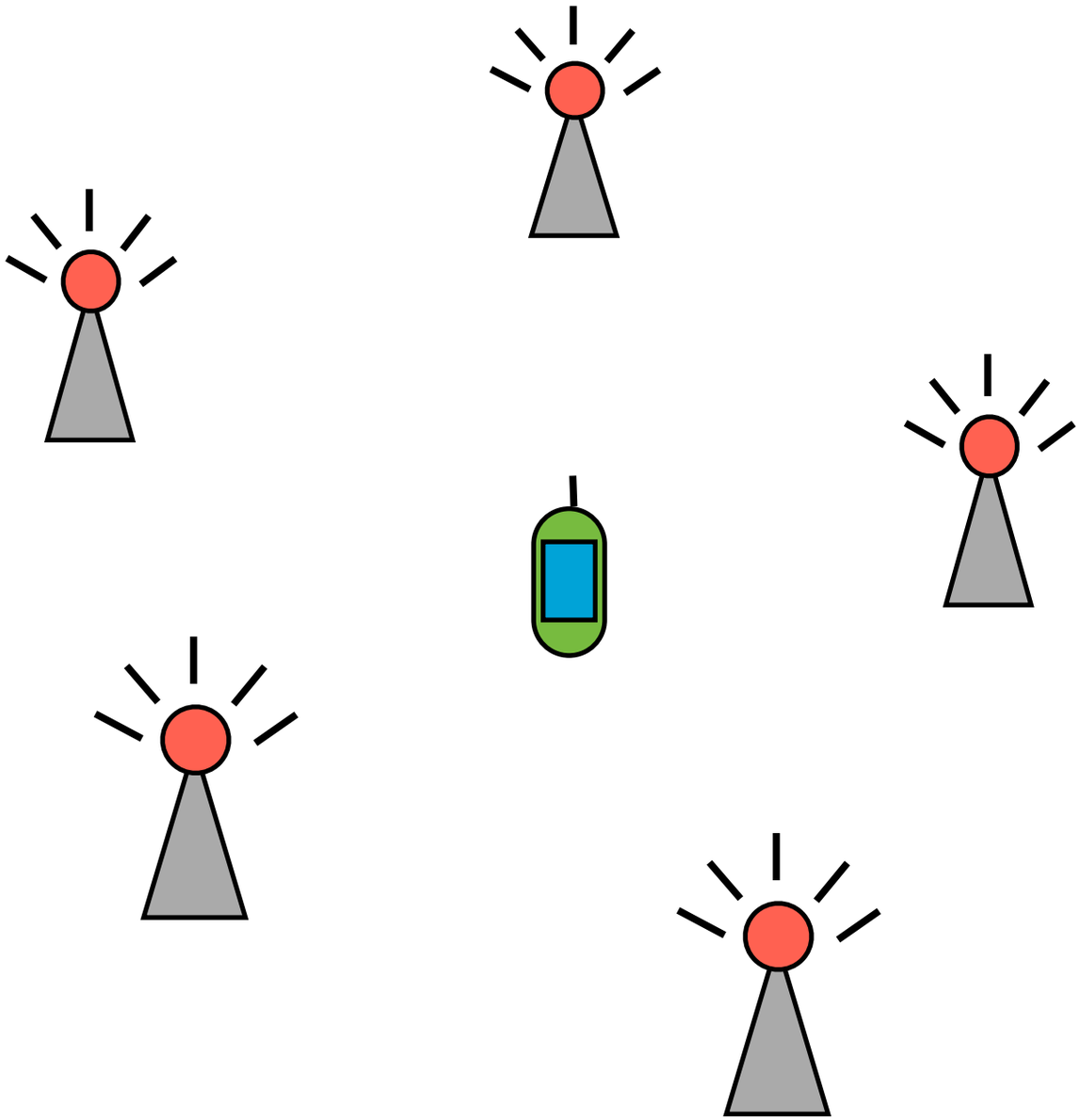

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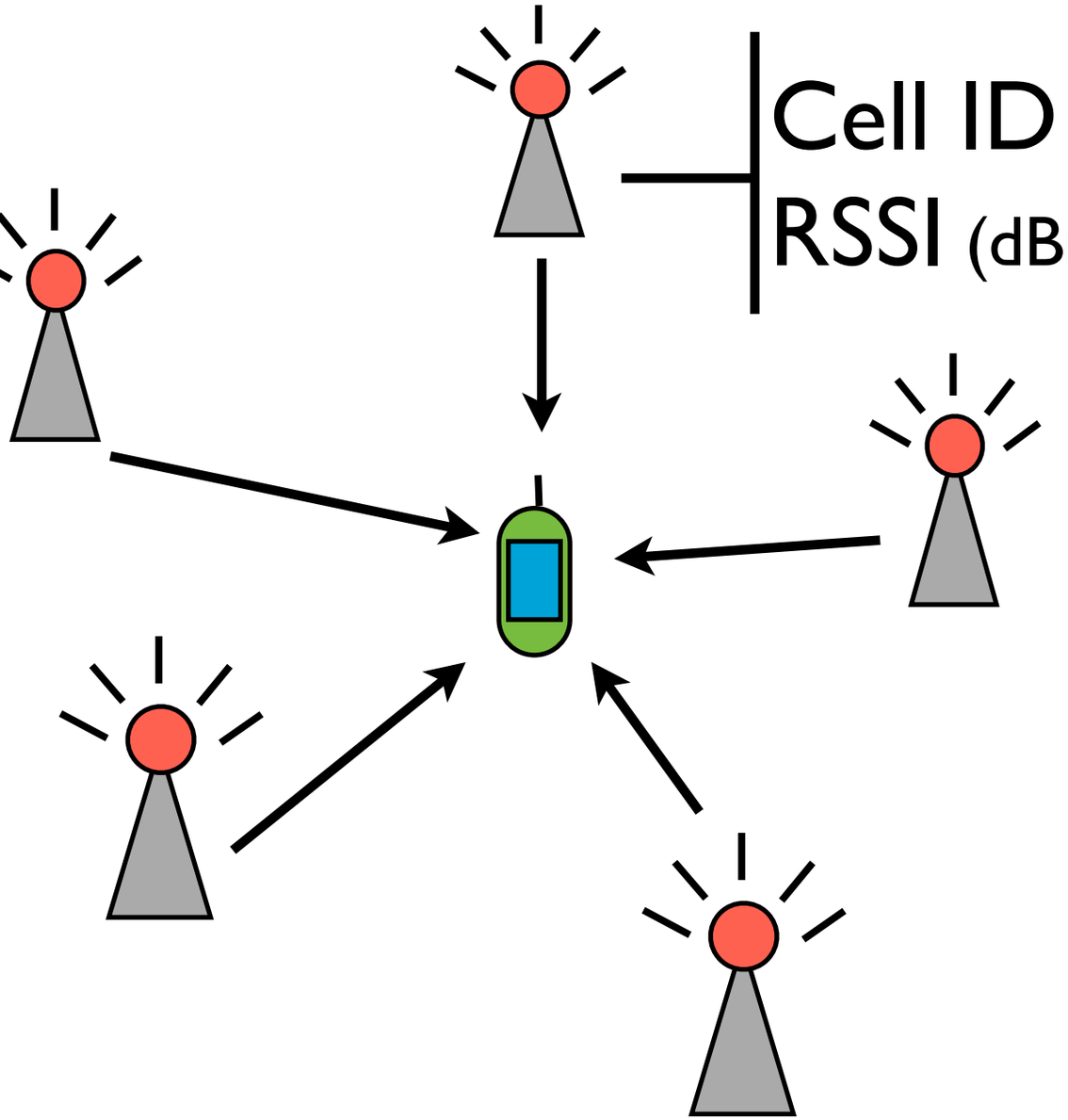

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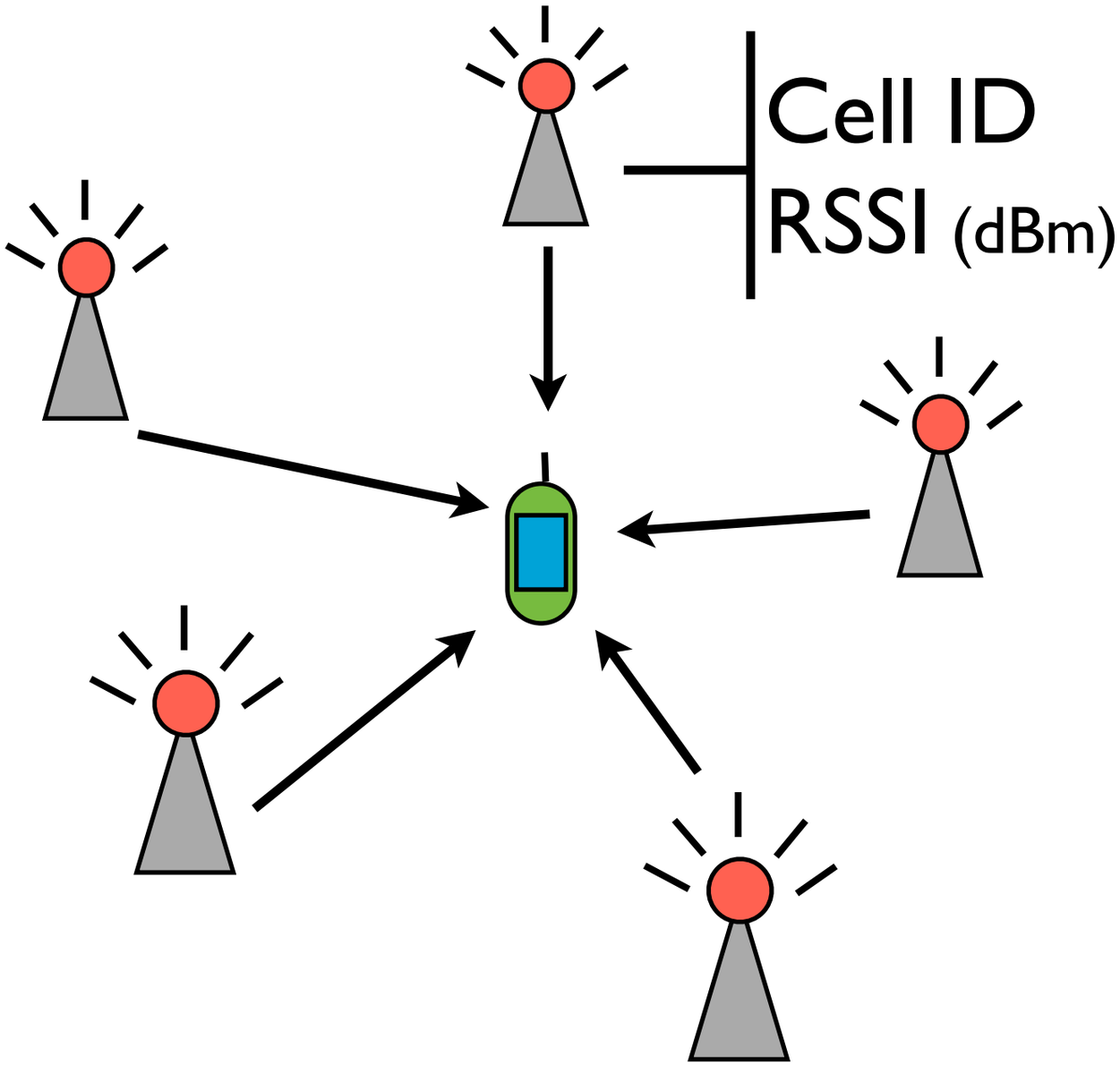
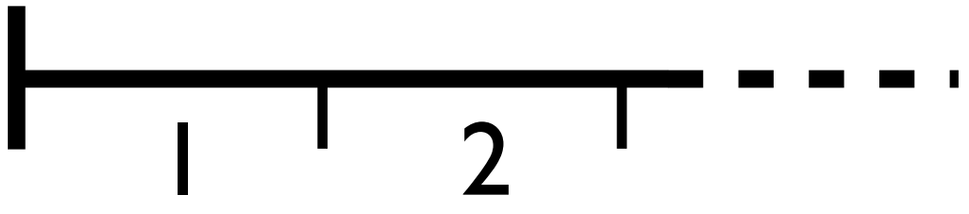


Cell ID
RSSI (dBm)

Sessions numbered
consecutively from 1 to N



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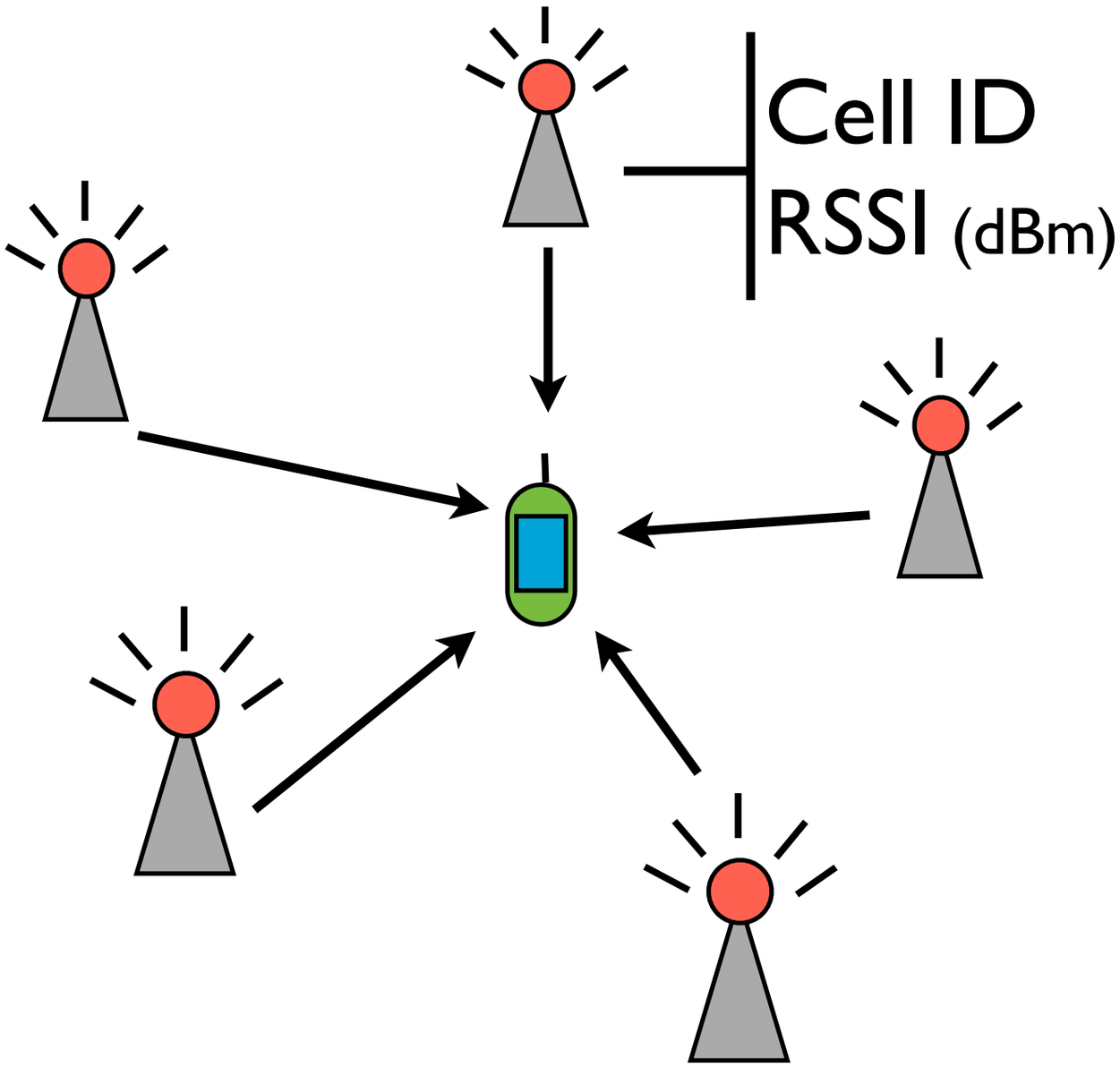

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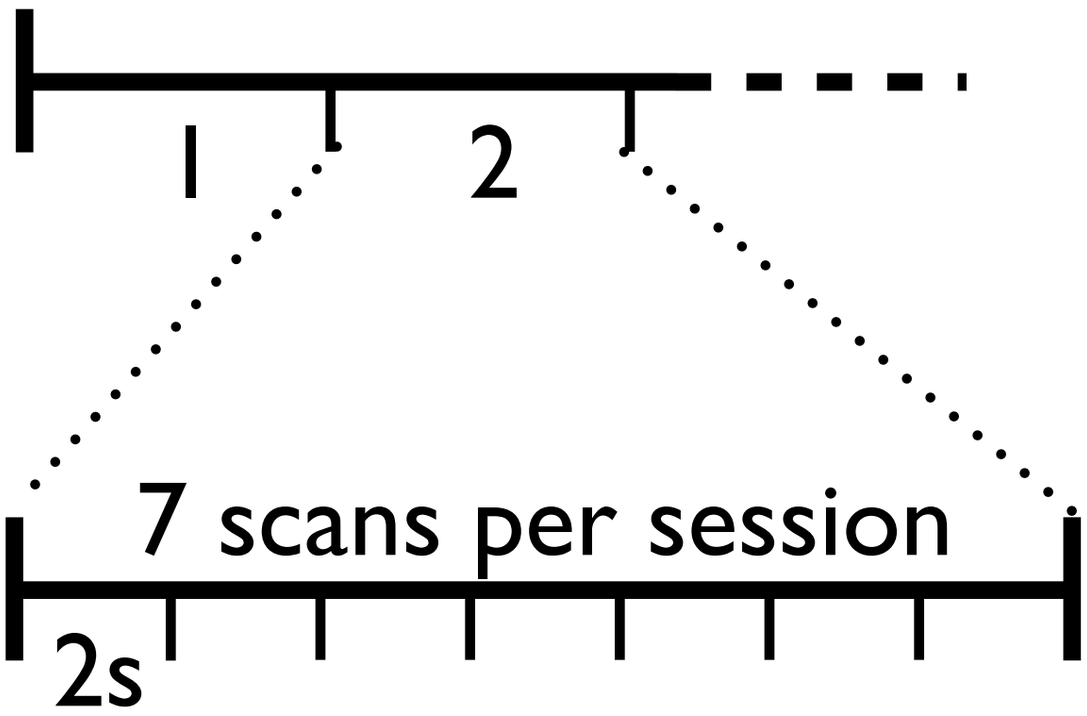

Mobility Sensor

Raw Data Collection

CellID	Alive sessions	Last session scans
64567	4	-90 -95 -89 -90 -86 -91 -87
65784	5	-75 -80 -72 -74
61254	2	-81 -86 -89

Mobility Sensor

Derive 3 features

Mobility Sensor

Derive 3 features

Features

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Alive sessions c.

Derive 3 features

Features
Median life time of cells

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Derive 3 features

Features
Median life time of cells
Average euclidean distance of signals

Mobility Sensor

Derive 3 features

Features
Median life time of cells
Average euclidean distance of signals
Average fast wavelet transform signal range

Mobility Sensor

Derive 3 features

Features	Fixed	Mobile
Median life time of cells	+	-
Average euclidean distance of signals	-	+
Average fast wavelet transform signal range	-	+

Mobility Sensor

Tree Classifier

Mobility Sensor

Tree Classifier

3 features

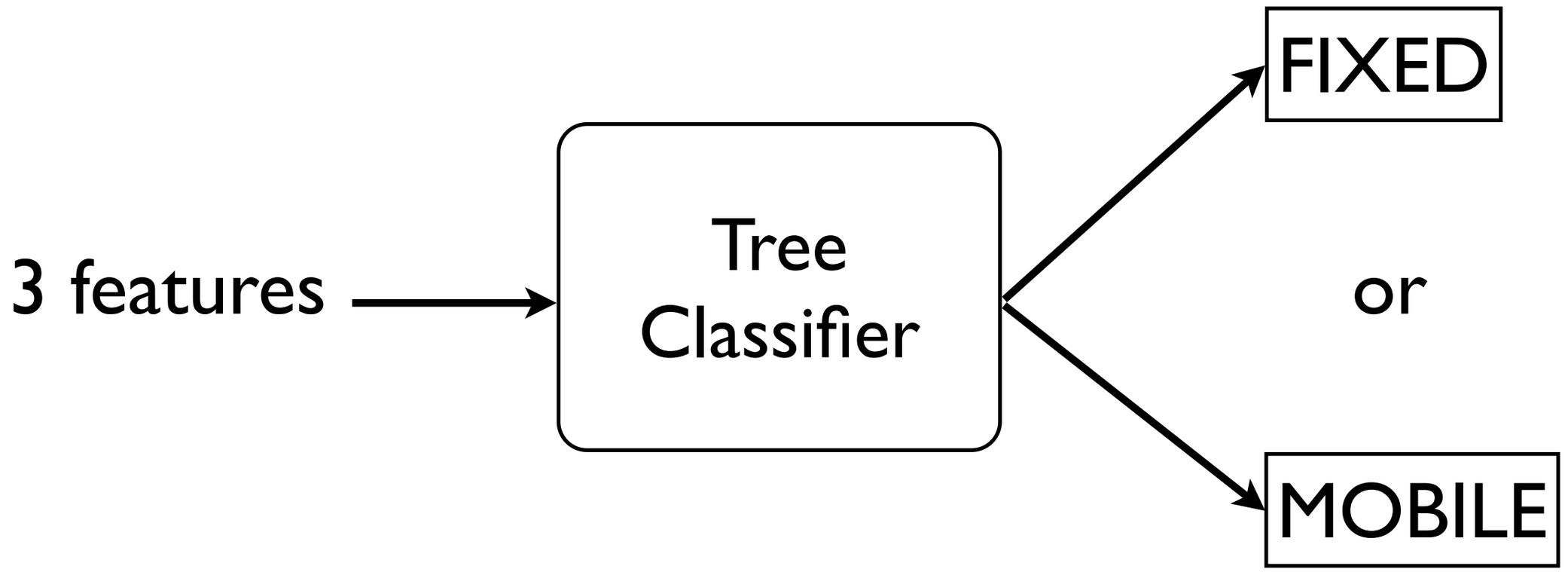
Mobility Sensor

Tree Classifier

3 features → Tree Classifier

Mobility Sensor

Tree Classifier



Preliminary Experiments

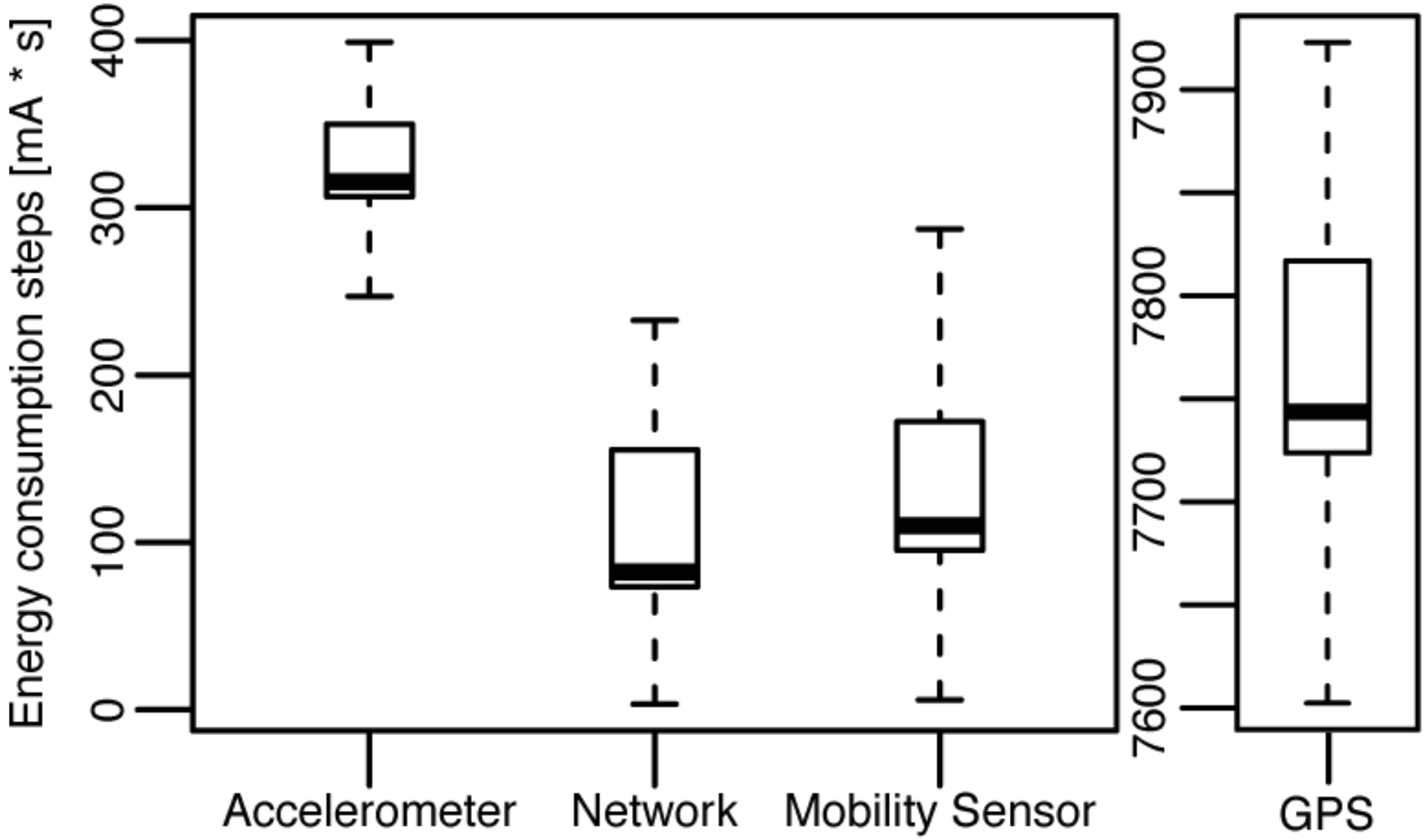
- Android phone
- 1 user, 5 days, 1 phone operator
- Mobility Sensor vs. accelerometer, network location and GPS
  - *mobile* and *fixed* states predictions
  - battery consumption
- User labeled the data (ESM with widget)

Results

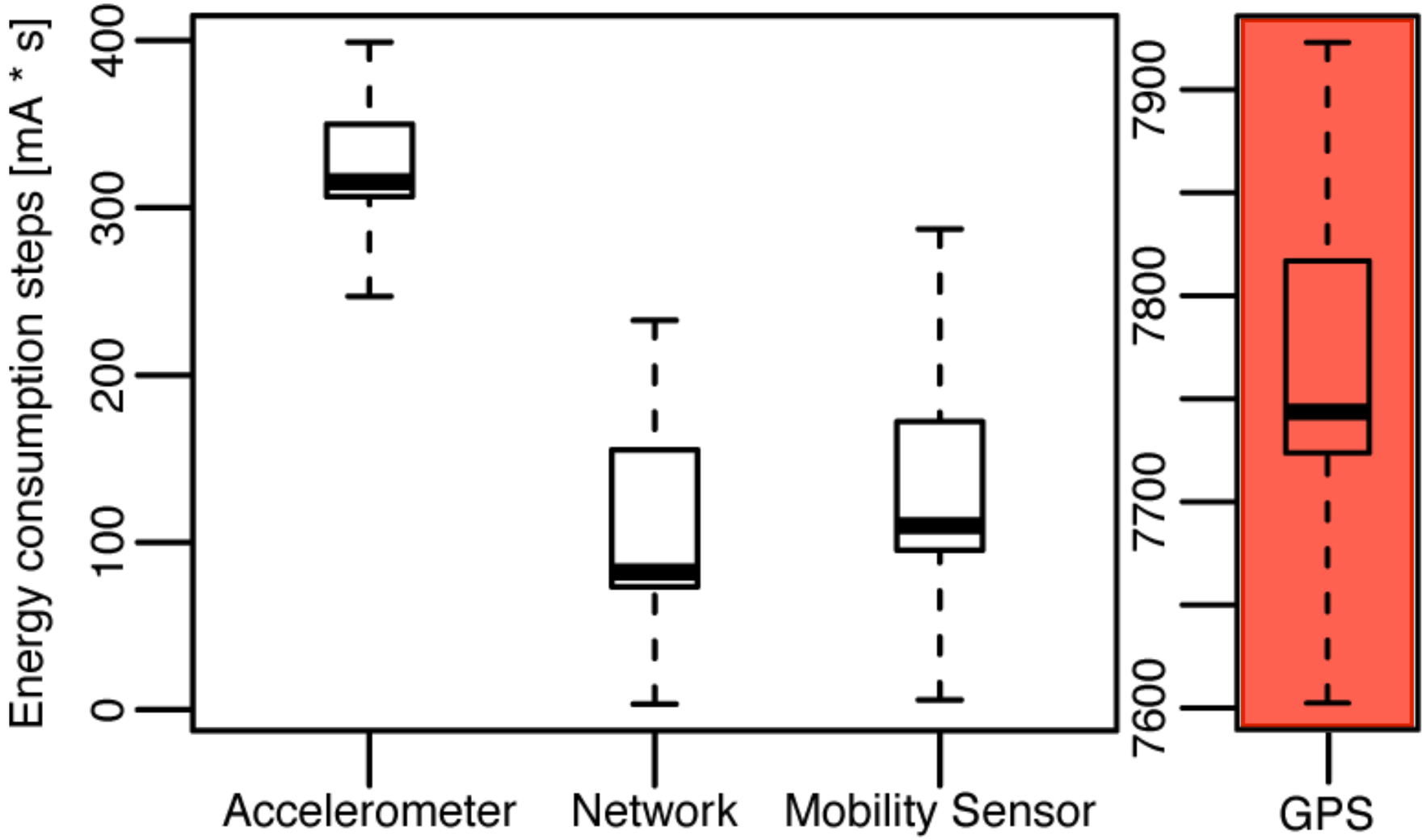
- 539 predictions
  - 52% Fixed
  - 48% Mobile
- 750 battery measurements

Results

Results


Energy consumption steps [mA * s]
0
100
200
300
400
7600
7700
7800
7900
Accelerometer
Network
Mobility Sensor
GPS

Results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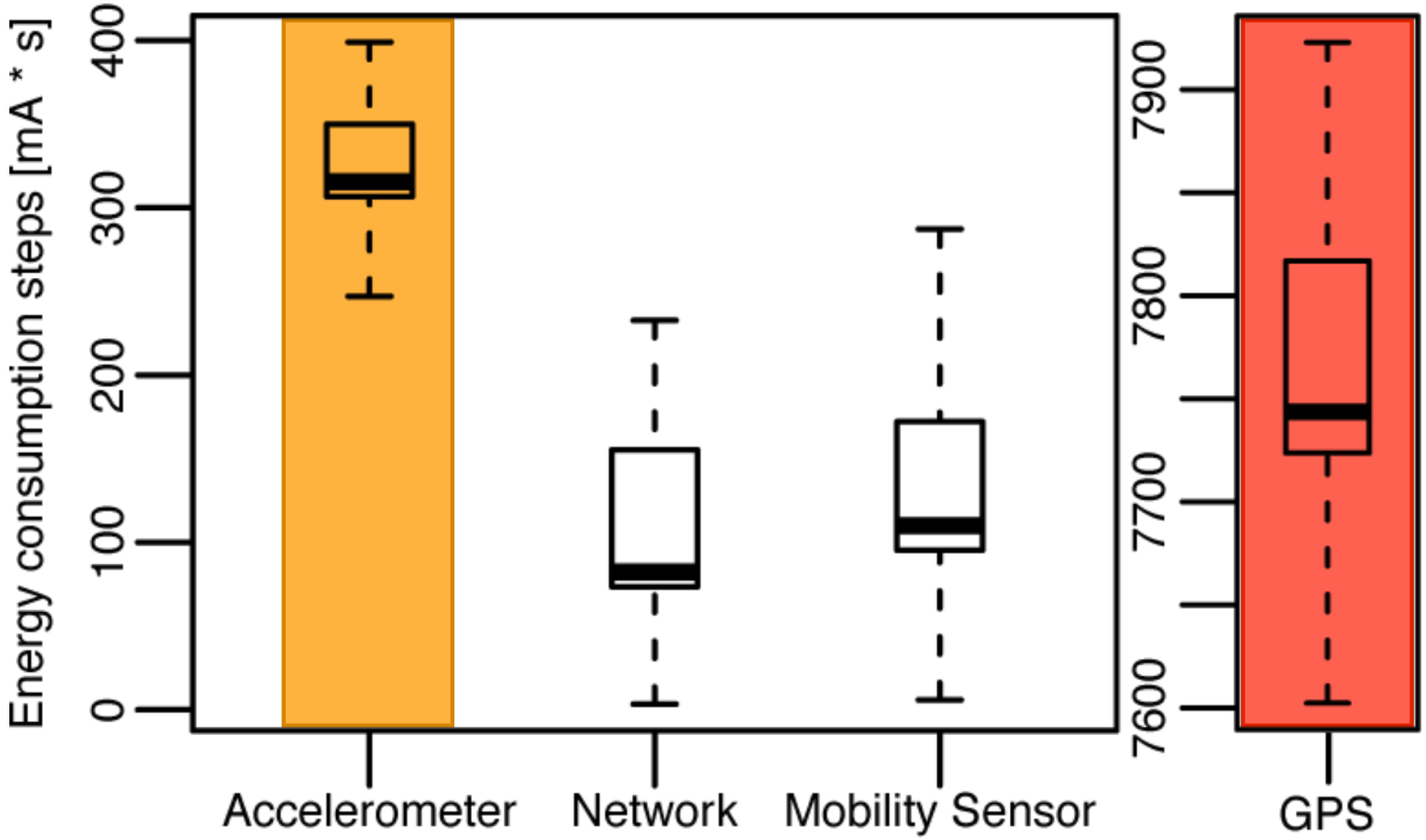
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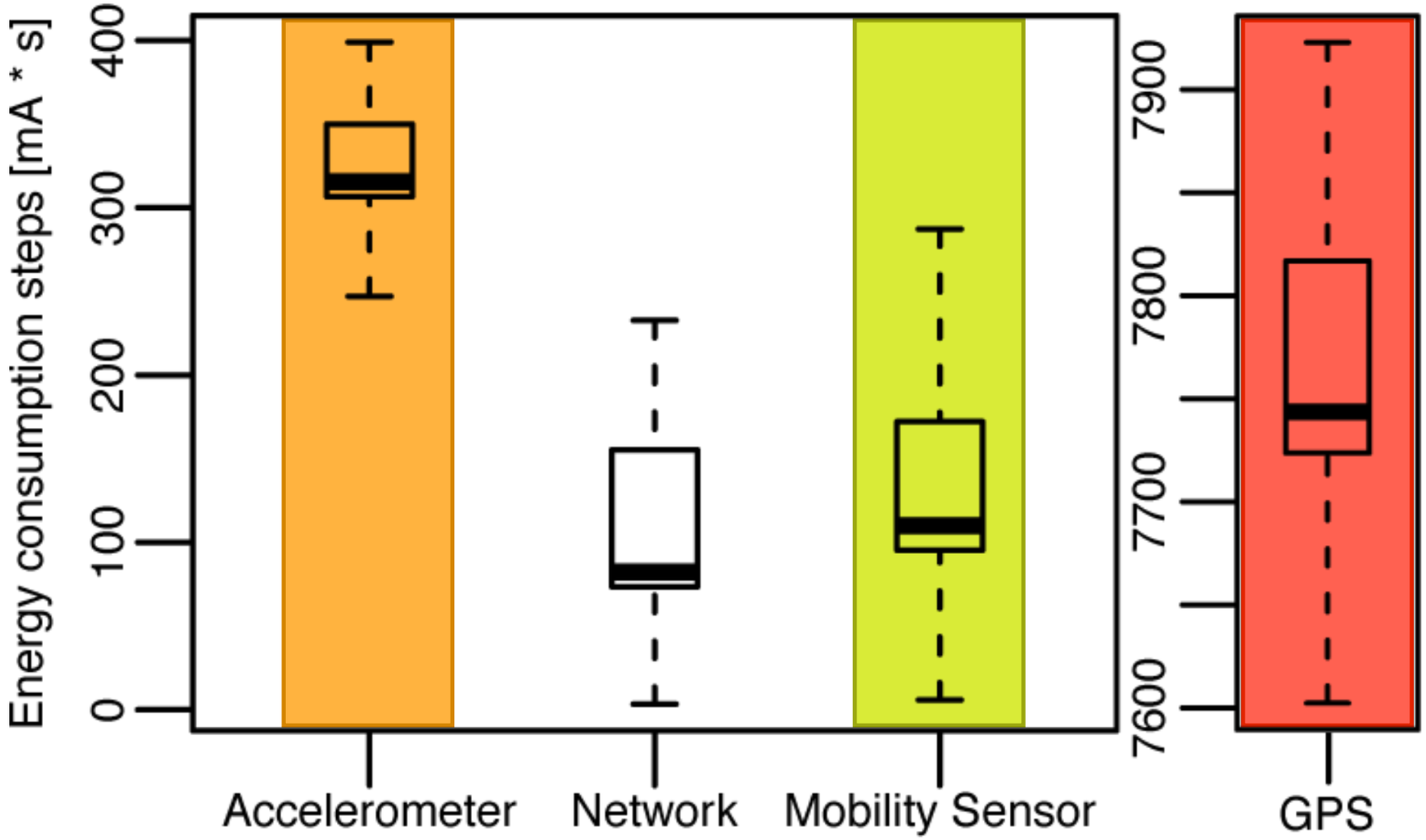
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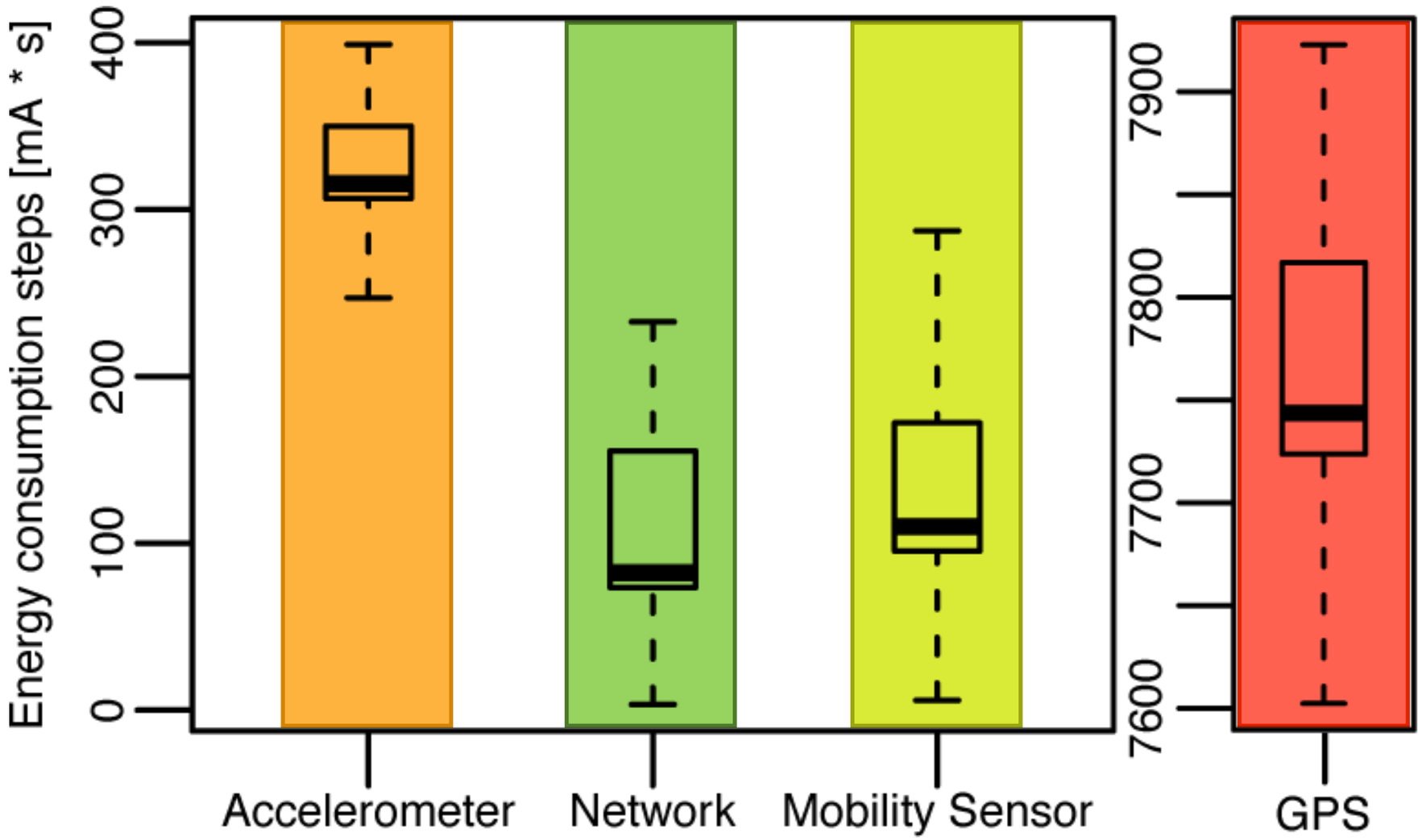
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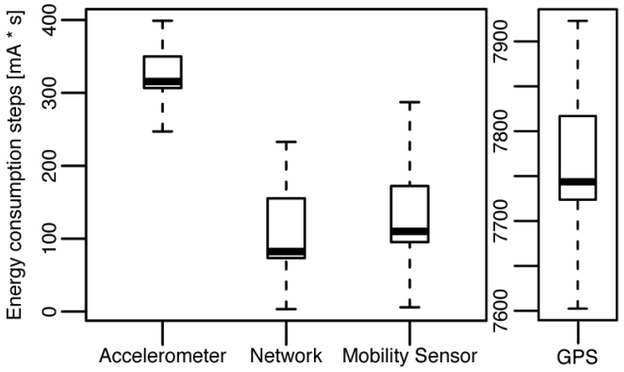
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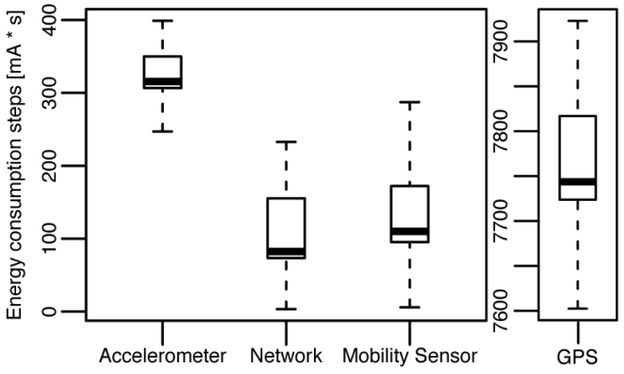
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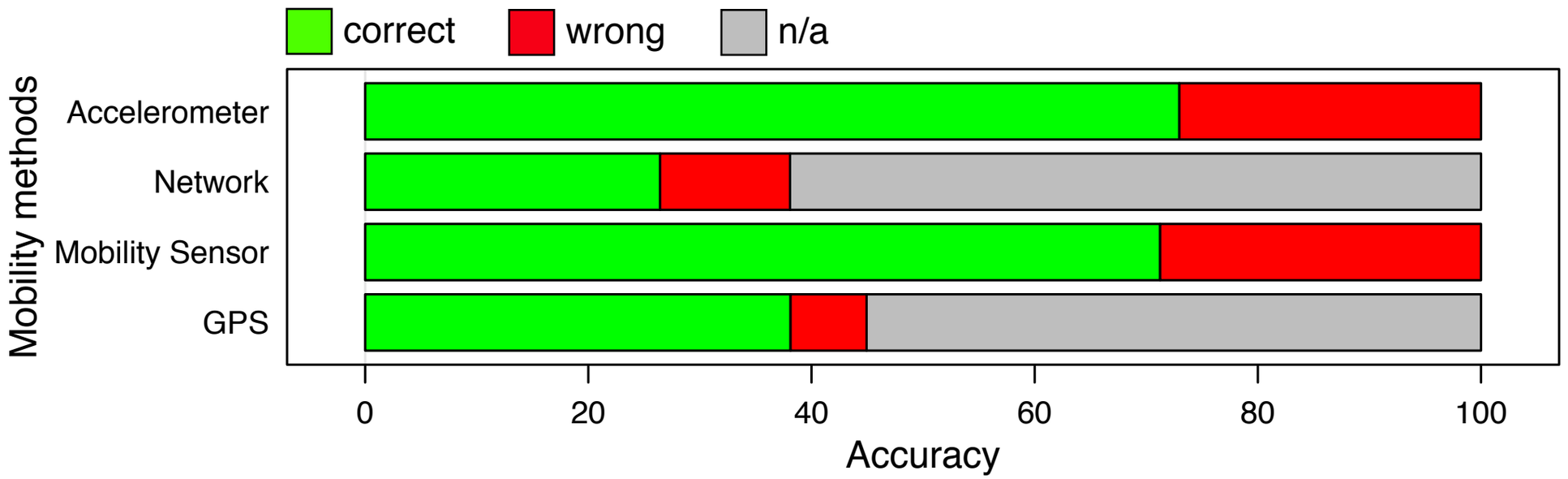
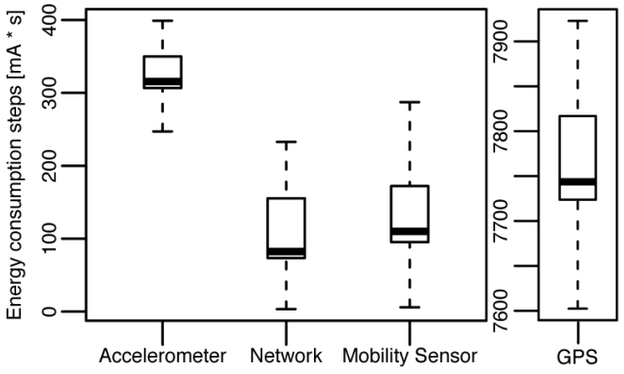

correct
wrong
n/a
Mobility methods
Accelerometer
Network
Mobility Sensor
GPS
0
20
40
60
80
100
Accuracy

Results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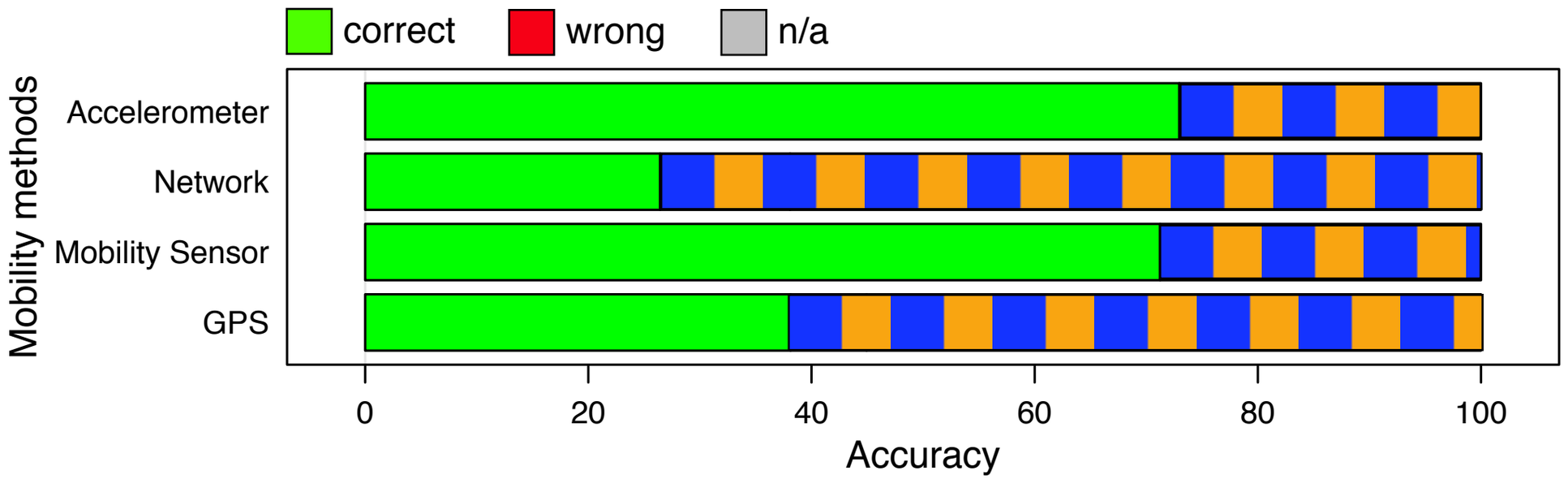
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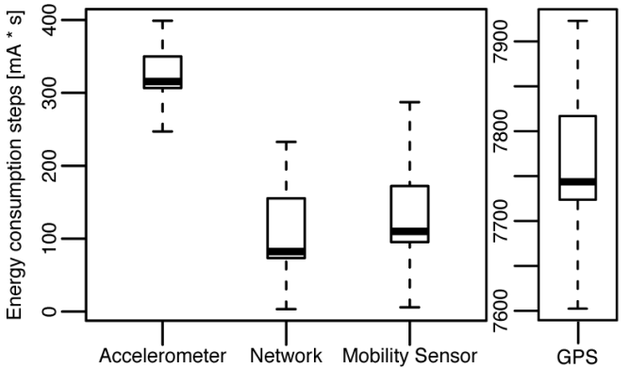
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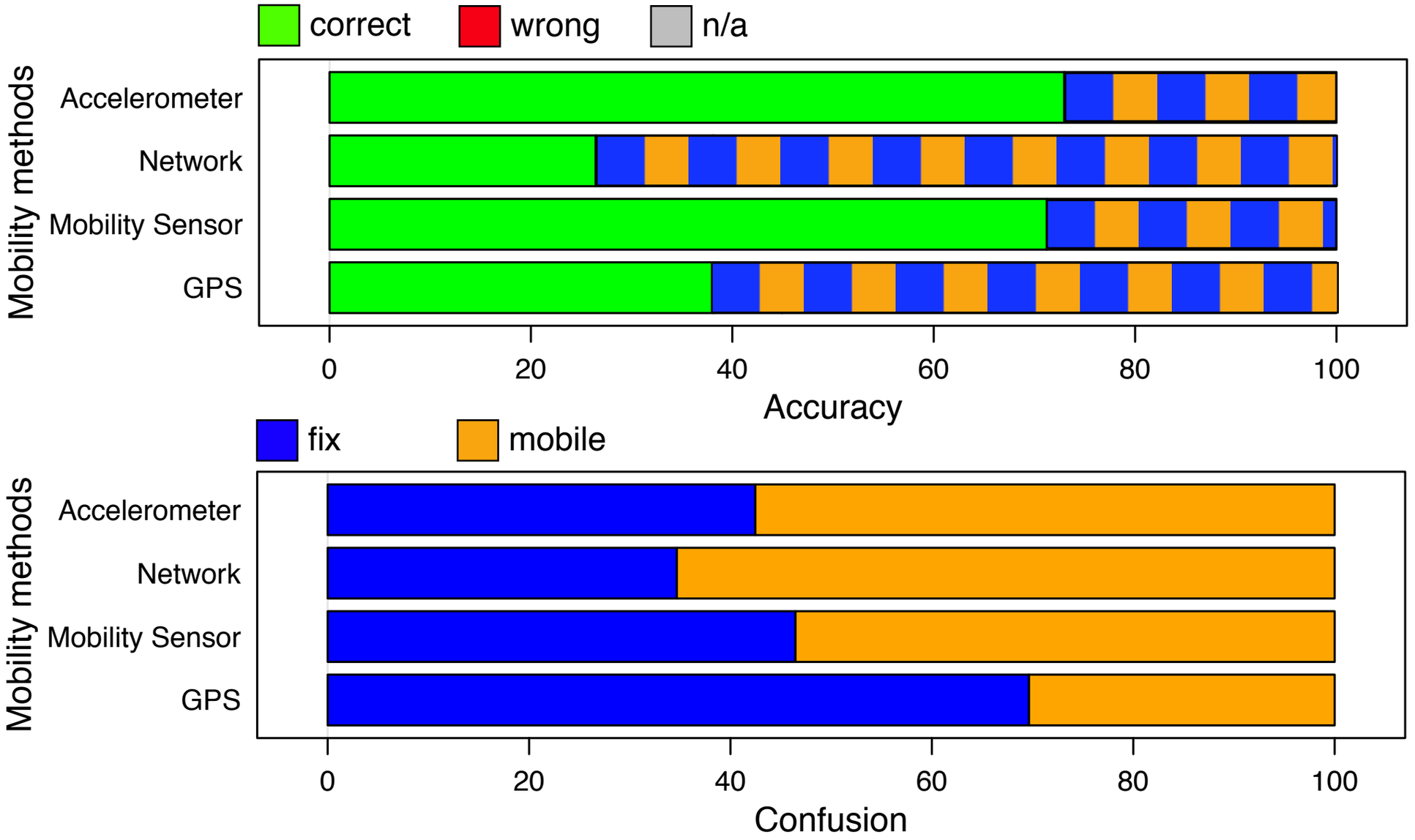
correct
wrong
n/a
Mobility methods
Accelerometer
Network
Mobility Sensor
GPS
0
20
40
60
80
100
Accuracy
fix
mobile
Mobility methods
Accelerometer
Network
Mobility Sensor
GPS
0
20
40
60
80
100
Confusion

Identified Problems

- Network coverage
- When **fixed**, network cell ping / pong
- When **mobile**, minimum number of cells

Ongoing Work

- Improve the algorithm
- Large case study involving real users
  - Mobile phone heterogeneity
    - neighbor CellIDs not always available
    - hardware battery consumption details
- Experience Sampling Method

Thank you!

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