

A background image of a misty forest with tall evergreen trees on a hillside, partially obscured by a thick layer of fog or low clouds.

Counting on openness

Privacy-safe passenger counting

2024-02-03
FOSDEM, BRUSSELS

HENRI SEIJO
MISTMAP

Mistmap operates in the intersection of urban mobility and open source.

Automatic passenger counting (APC)



original photo by Willem 90, CC0:
https://commons.wikimedia.org/wiki/File:Arriva_Spurt_Interieur_2e_klasse_zicht.jpg

For passengers

- Avoid crowding
- Future: know in advance if space left for pram

For authorities

- Reallocate vehicle capacity
- Climate effect reporting
- Pandemic precautions
- Even load

Waltti-APC

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2022–2023

Main task

Reduce cost and vendor lock-in of future APC procurements

Interviews, workshops, sketching...

**1. Create API spec between
onboard devices and backend**

Learned from HSL

```
{
  "APC": {
    "vehiclecounts": {
      "countquality": "regular",
      "vehicleload": 16,
      "vehicleloadratio": 0.2,
      "doorcounts": [
        {
          "door": "1",
          "count": [
            {
              "class": "adult",
              "in": 2,
              "out": 3
            }
          ]
        }
      ]
    }
  },
  "tst": "2019-05-23T14:15:16.000Z",
  "tsi": 1416308975,
  "desi": "555",
  "dir": "1",
  "oper": 12,
  "veh": 10,
  "lat": 24.9435,
  "long": 60.1967,
  "odo": 45.12,
  "oday": "2019-05-23",
  "jrn": 1,
  "line": 264,
  "start": "13:40",
  "loc": "GPS",
  "stop": "1234567",
  "route": "2551"
}
```

```
{
  "APC": {
    "schemaVersion": "1-1-0",
    "countingSystemId": "3298a747-c434-4030-b6d7-ab803bd823d2",
    "messageId": "06e64ba5-e555-4e2f-b8b4-b57bc69e8b99",
    "tst": "2019-05-23T14:15:16.123Z",
    "vehiclecounts": {
      "countquality": "regular",
      "doorcounts": [
        {
          "door": "1",
          "count": [{ "class": "adult", "in": 2, "out": 0 }]
        }
      ]
    }
  }
}
```

2. Prototype new counting technologies

- Deal Comp: security cameras
- Emblica: mmWave radar
- Telia: stereo cameras above doors (reference device)



“mmWave counter prototype”
by Jyväskylä Region Public Transport Authority,

CC-BY-4.0



“Stereo camera counter”
by City of Kuopio, CC-BY-4.0

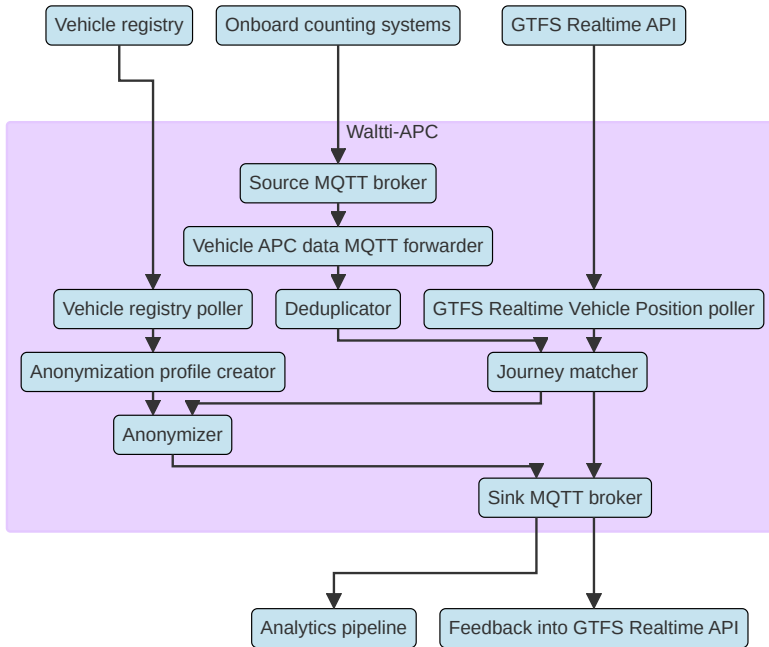


20 k€ per new tech not
enough for breakthrough,
this time

“Pretty Muddy Race for Life Cheltenham 2017” by Saddy Fodie, CC0:

<https://www.flickr.com/photos/150600245@N03/35510147765>

3. Build open-source backend



Anonymization

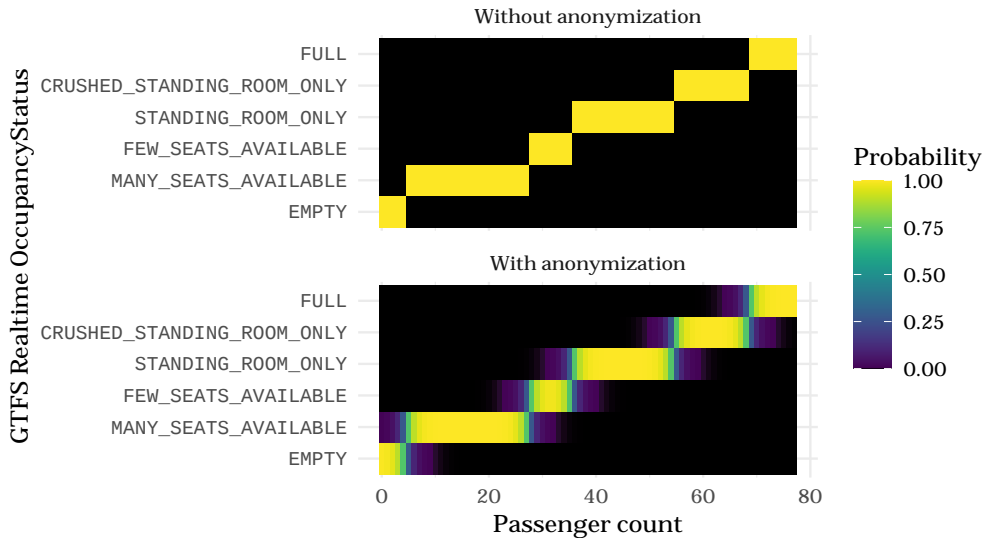
Consider Alice...

Binning values into OccupancyStatus categories, e.g. 5–20, does not anonymize!

A research group from the Finnish Center for Artificial Intelligence developed a very strong anonymization method based on differential privacy (DP).

Thank you Jälkö, Räisä, Heikkilä, Honkela!

Usage with the vehicle model VDL Citea LLE-120.255



Trip summary

Check out our:

1. API spec
2. backend code or architecture
3. anonymization method

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Main repo: [https://github.com/
tvv-lippu-ja-maksujarjestelma-oy/
waltti-apc](https://github.com/tvv-lippu-ja-maksujarjestelma-oy/waltti-apc)

API spec: [https://github.com/
tvv-lippu-ja-maksujarjestelma-oy/
waltti-apc-vehicle-specification](https://github.com/tvv-lippu-ja-maksujarjestelma-oy/waltti-apc-vehicle-specification)

Anonymization tool:
<https://transitprivacy.org>