FourC AS

- Founded autumn 2013
- 11 employees, ~7.5 FTE
- Offices in Trondheim, Norway and Gloucester, UK
- +30 FTE experience in ICT solutions for public transport
The OpenSP project

www.opensp.eu
Project OpenSP

R&D project with Norwegian PTAs:

“Open Service Platform for Public Transport”

- Introduce “software-as-a-service” (SaaS) for public transport (also....)
- Create open “marketplace” in the vehicle
- Cheaper and more efficient operations
- Make it easier to install, test, integrate new services
- Drive innovation to introduce new and better solutions
Project OpenSP - facts

- Funded with grants from Research Council of Norway and Innovation Norway
  Forskningsrådet
- 3 years: March 2015 to March 2018
- Research partner
  SINTEF
- Commercial partners:
  Evry
  Bank Axept
  Nets
Project OpenSP - partners

4 counties and PTAs:

- AtB (Sør-Trøndelag county)
- Kolumbus (Rogaland county)
- Troms Fylkestrafikk (Troms county)
- North Trøndelag county

- Covers 1.1M people (>20% of Norwegian population)
- Pilot testing has started
- Project web page:
  www.opensp.eu
Project OpenSP - services

Service platform to be installed and demoed with at least two “services”:

1) **Sensor-based and anonymous passenger flow analysis**

2) **ID- and account based ticketing system supporting several types of identifiers**
The Cities in Motion Passenger Flow Analysis service
“Classic” passenger counting

- Usually some kind of camera based
  - I/R
  - Stereoscopic
  - Image analysis
- High purchase cost
- Expensive installation
- Specialized hardware
- Does not measure travel distances/stop to stop statistics
- Does not work with transfers from vehicle to vehicle
Cities in Motion
Passenger Flow Analysis

- Detects signals from passengers’ electronic devices
  - WiFi
  - Bluetooth
- Uses standard commodity and reusable hardware
- Estimates number of passengers per trip, route, etc. using statistical models
- Intelligent filtering and machine learning
- Accuracy comparable to state-of-the-art camera based systems
Cities in Motion
Passenger Flow Analysis

- Passenger flow analysis is more than classic counting

- Estimates flow of passenger from journey entry point A to destination point B, including transfer from vehicle to vehicle and between routes

- Important data for travel system optimization and change planning

www.fourc.eu
Cities in Motion
Passenger Flow Analysis

- No mobile app needed -- completely autonomous
- Completely **anonymous** and in compliance with NO, SE and EU privacy regulations
  - The Norwegian Data Protection Authority
  - Västerås case
- Statistical models, not following individuals
- Data can be augmented and improved using additional data sources, including classic APC
- Handling spoofed mobile data and privacy measures in mobile OSes
Passenger Flow Analysis, early field test, January 2016

Rute 8 - Stavset - til Fiolsvingen

Observed  PFA  APC
Accuracy vs camera-based APC?

The Result

The accuracy of the APC system varied from 57% to 94% on the 8 trips made. The overall accuracy of the APC solution was 82%.

The accuracy of Four C’s PFA solution varied from 74% to 89% on the same trips. The overall accuracy of PFA was exactly the same as the costly APC system, i.e. 82%!  

www.fourc.eu
PFA compared to camera-based systems

Tests shows that current PFA algorithm works comparable and even better than camera-based systems. The following is from four trips in May 2016.

Normalised mean absolute error (NMAE):

<table>
<thead>
<tr>
<th>Trip #</th>
<th>FourC PFA</th>
<th>APC camera-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>86%</td>
<td>65%</td>
</tr>
<tr>
<td>2</td>
<td>85%</td>
<td>72%</td>
</tr>
<tr>
<td>3</td>
<td>81%</td>
<td>55%</td>
</tr>
<tr>
<td>4</td>
<td>84%</td>
<td>67%</td>
</tr>
</tbody>
</table>

Note: Figures based on field tests performed 2nd May 2016. Further tests will be performed to verify figures.
Route data based analysis

The figure shows:
- three bus lines (green, blue, orange)
- bus stops (circles)
- signal observations (red crosses)
- the most probable route travelled (red line)
Large scale testing

- Large scale testing as part of the OpenSP project
  - Appx 30 buses in Stavanger, Norway by end of 2016
  - Buses in Trondheim in 2017

- Commercial pilot tests planned

- More test cases = better models
The Cities in Motion Service Platform
Cities in Motion Service Platform

- Run multiple services (apps) on vehicle computer
  - Passenger Flow is just one service!
- Basic fleet management
- Over-the-air Service management (add new services, update, etc)
- Device monitoring and metrics
- Remote control
- Single sign-on
- Theft protection/tracking
- All data available on open API and GUI
Current Services for Transportation

Service Platform
- Remote control, management, maps, SNMP, security, virtualization, monitoring, message system, ...
- Unique: API-free GUI integration; combine Android, Linux, OSGi, etc, on same device
- Beta version in live commercial use

LiveScreen
- Infotainment based on Dogu AS’ LiveScreen
- World’s first digital signage with programmatic advertising for transport
- In commercial use

Passenger Flow Analysis
- Analyses passenger movements in transport system using disruptive methods
- As accurate at legacy APC systems
- Patent pending

Passenger Wi-Fi
- Internet access for passengers
- Disruptive tech: No need for specialized Wi-Fi hardware!
- Commercially available

www.fourc.eu
Thank you

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