MEGASENSE FOR SMARTER CITIES

Megasense is scalable and intelligent real-time environmental monitoring system that utilizes 5G network, AI and IoT

Megasense combines world-class science with high business potential

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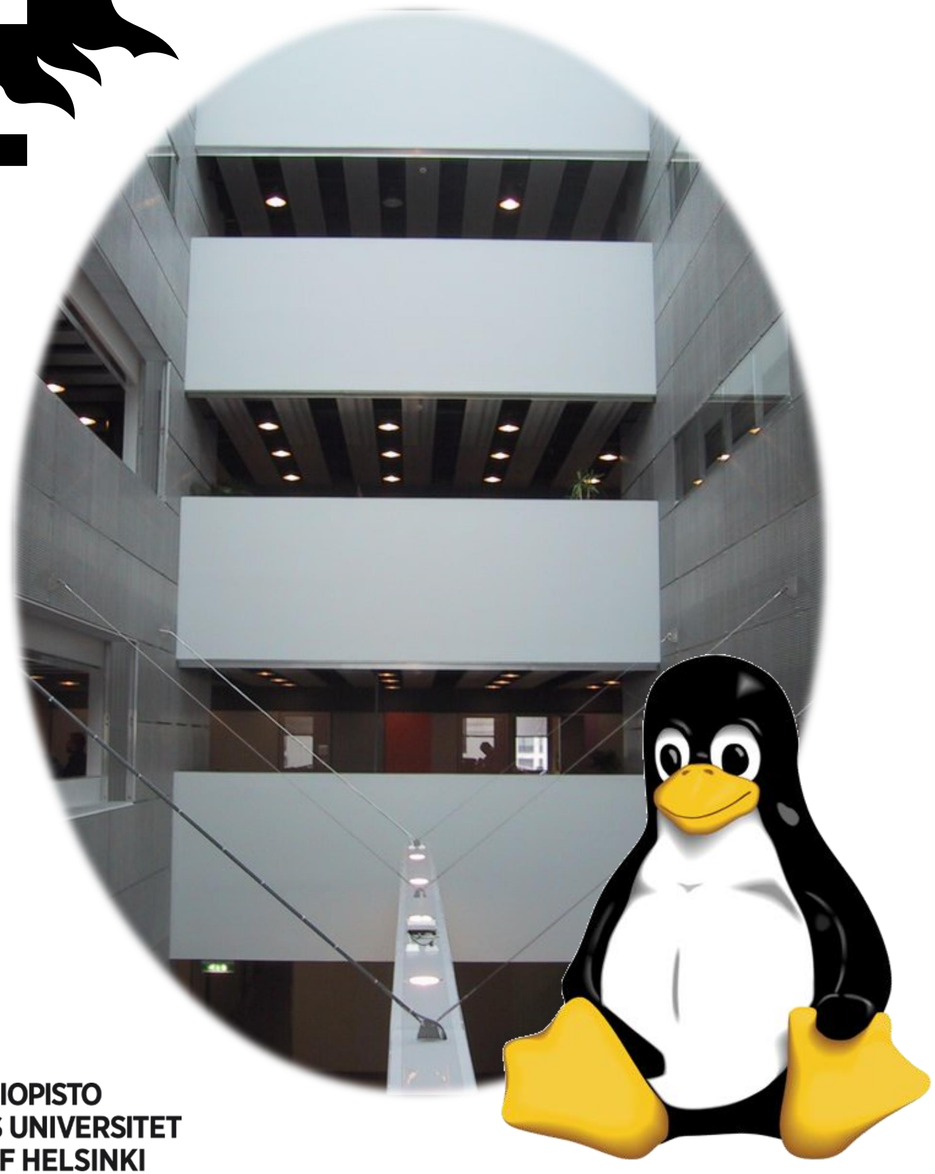
52 Years of Excellence



- **Department of Computer Science**
  - Among top CS Departments in the Nordics
  - The number of professors has grown from 16 in 2017 to **29** in 2019.
  - Approx. 200 staff members in 2018

- **Architects of the Digital World**
  - **Core CS and Data Science**
  - Algorithms, AI, Networking, Software

- Helsinki Institute for Information Technology **HIIT**
- Finnish Center for AI (**FCAI**)
- Helsinki Center for Data Science (**HiDATA**)
- Nokia Center for Advanced Research (**NCAR**)

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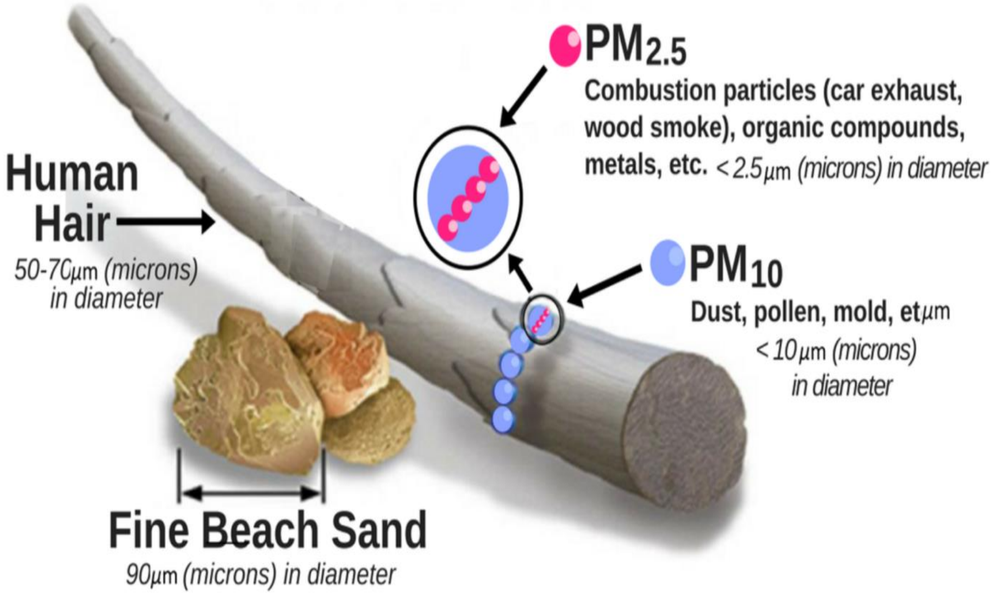
Real World Problem: Air Pollution - Largest Health Risk

According to World Health Organization (WHO) in 2018

- 91% of world population breathe polluted air
  - Ambient air pollution results in 4.2 million deaths each year
  - Household air pollution results in 3.8 million deaths each year
- 97% of cities in low- and middle-income countries with more than 100,000 inhabitants do not meet WHO air quality guidelines
- 93% of children under 18 years play and live with air pollution



Small particles and acid gases causes air pollution

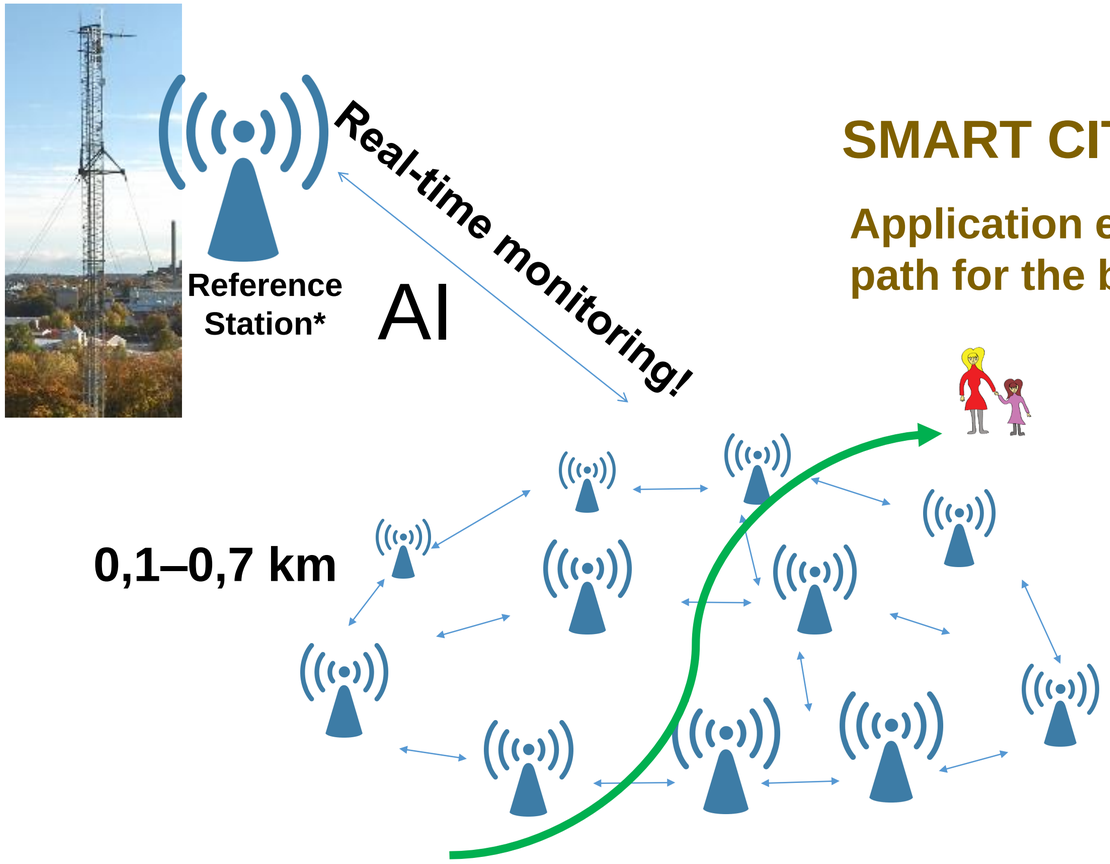
Digital Solution : Low Cost Sensing and Real-Time Data Science

- UHEL designs Low cost sensor devices across the environment supported by 4G NB-IOT network leading to a viable 5G service

- UHEL AI calibration by highly accurate refence station such as atmospheric science SMEAR* Station

Enables multiple applications:

- City planning, health and wellbeing, wearable and fitness devices, vehicular technology, mobile apps, HD-maps



SMART CITY

Application example: Green path for the benefit of citizens

High density of stations (IoT) = accurate and timely air quality monitoring

Monitoring stations in urban and rural areas. Multiple ways to use sensors.

https://sdt.metatavu.io/

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SMEAR* = Station for Measuring Earth Surface-Atmosphere Relations (SMEAR)
https://www.atm.helsinki.fi/SMEAR/

Air Pollution Smart Project: URBAN SENSE (2018-2019)

Ecosystem: University of Helsinki, Vaisala, Elisa, Nokia, and Forum Virium

•**Urban Sense** is a pilot project for MegaSense funded by the City of Helsinki. In Urban Sense low-cost stationary sensors are distributed around Kumpula area in Helsinki, to generate a 5G testbed of low-cost sensor network

Current activities:

•50 low-cost sensors in the city environment (bus stops)

•Software design:

- Calibration deep learning algorithms
- MegaSense back end at the University of Helsinki
- Business API for companies to develop AQ solutions

Low cost air quality stationary sensor with NB-IoT modem installed in local bus stop

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Air Pollution Smart Project: UIA HOPE (2018-2021)

Ecosystem: City of Helsinki, University of Helsinki, Forum Virium, Vaisala, HSY, Useless and FMI

•**HOPE** (Healthy Outdoor Premises for Everyone) is funded by EU. In HOPE dense air quality monitoring and urban planning interventions are used to influence citizen behaviour

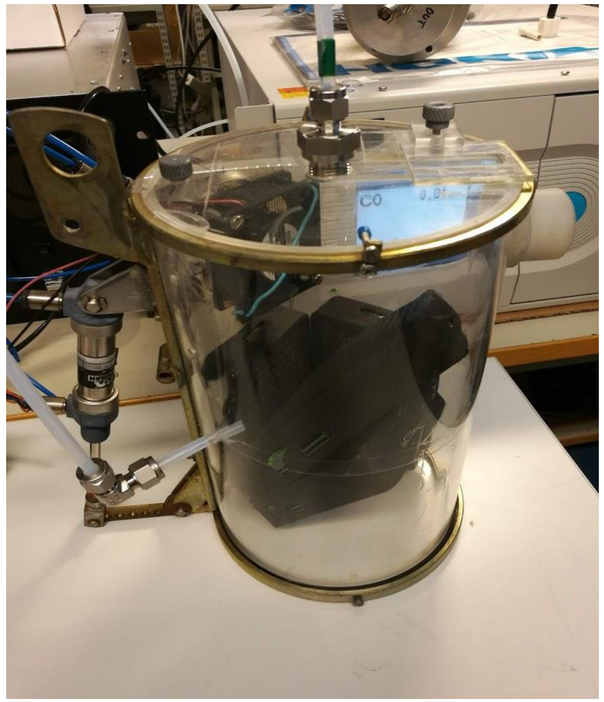
Current activities:

•100 portable developed by the CS Department and calibrated by INAR & HSY to identify hyper-local hotspots and create personal exposure maps

- Citizens from Jätkäsaari will be lent sensor devices with mobile app at the end of May 2019

•Data fusion with Vaisala/HSY network using FMI models

•INAR led AQ2.0 (virtual sensing with new AQ proxies)



Laboratory calibration of portable low cost air quality sensor with Bluetooth connectivity to mobile phone. Readings: Environmental data, CO, NO2, O3, PM. 1.0, PM 2.5, PM 10.0

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Data Fusion: Low Cost Indoor Sensing for Smarter Offices

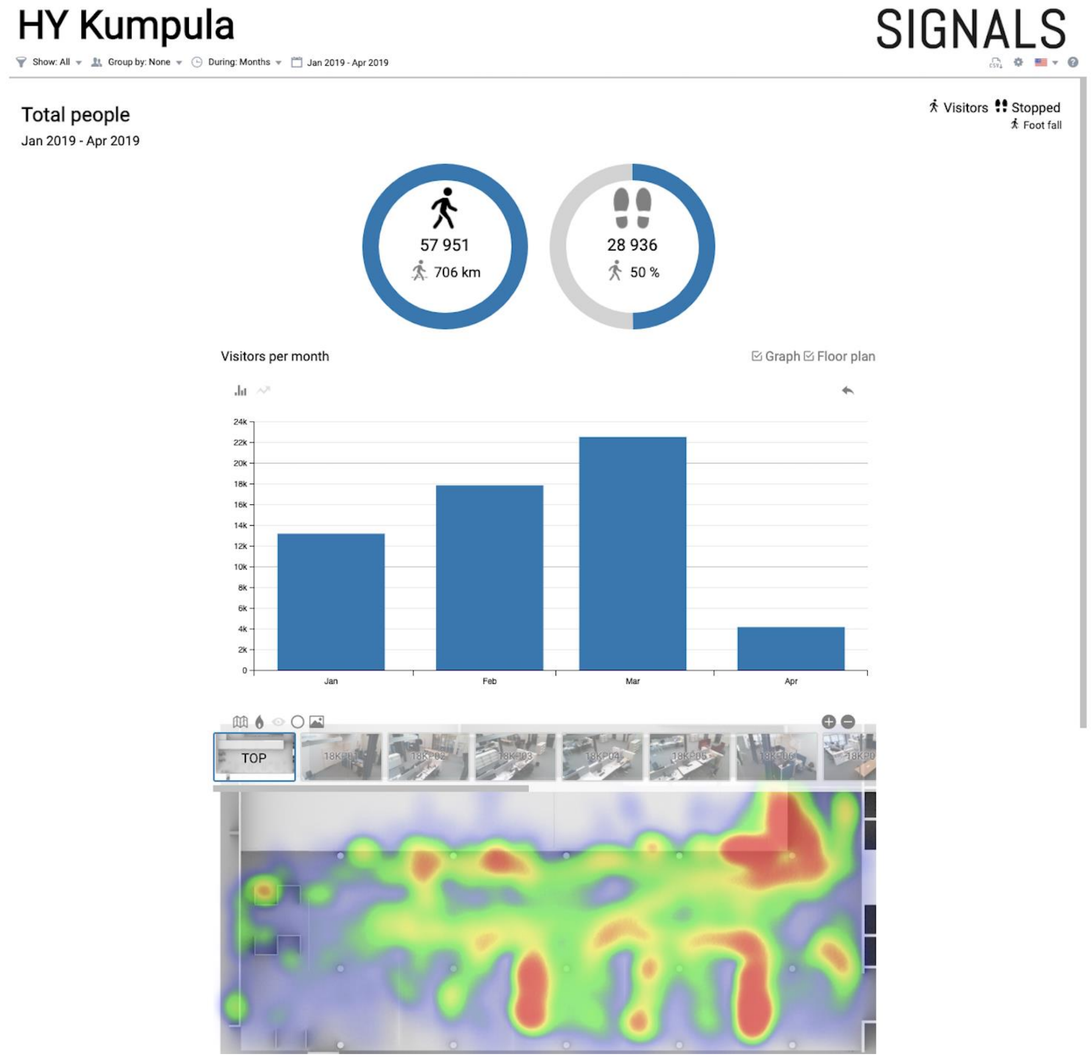
The average person spends a considerable amount of time in public utility premises (up to 40% of a day)

MegaSense investigated the extent of resuspended particulate matter (PM2.5) caused by human movement and gathering (CO2) at a Smart office workspace (UbiCampus) fusing motion sensors low-cost AQ sensors and camera data

MegaSense preliminary findings show:

- Human movement and gathering is a factor for exposure to PM2.5 near areas where people sit in the indoor workspaces

- Ventilation system is an important factor for the exposure of CO2. CO2 tended to be higher when the ventilation system is either off or running at a low setting during the night time



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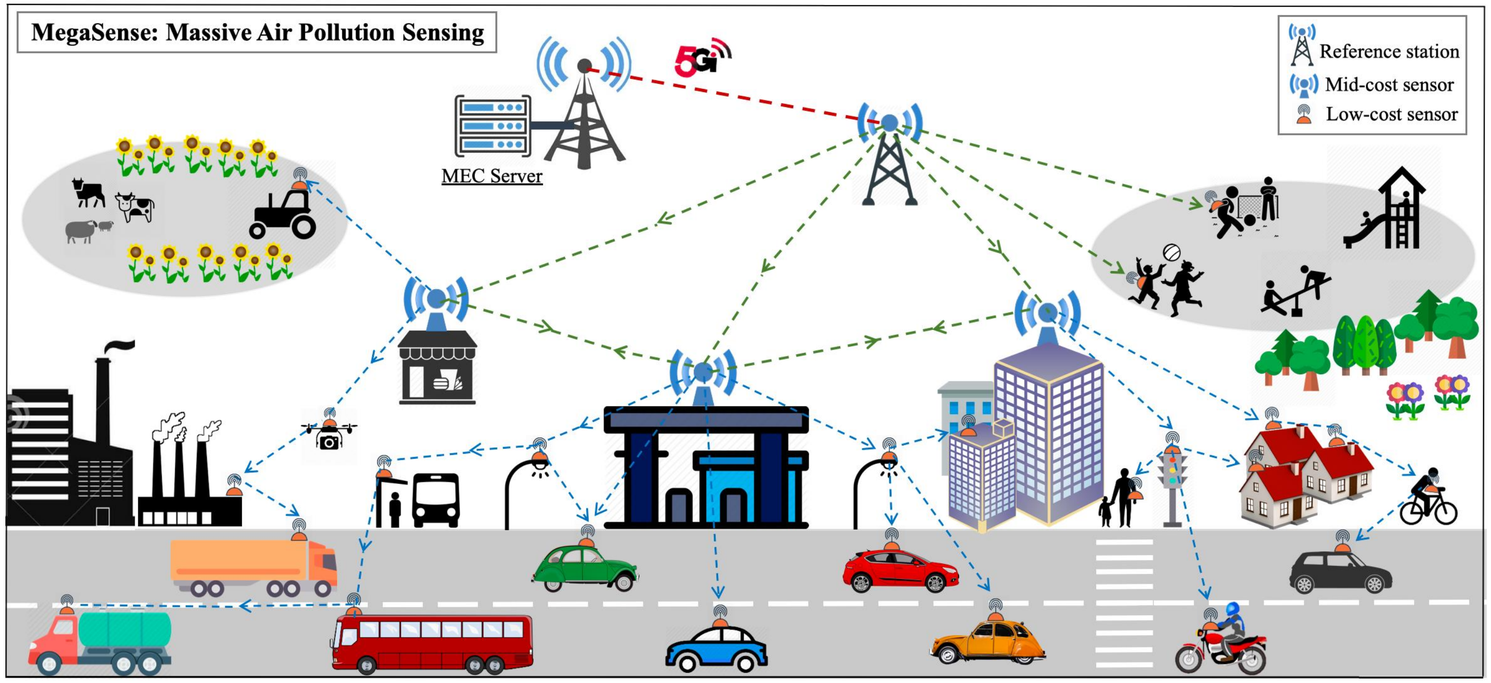
MegaSense as a 5G Vertical Application

A 5G network slice for air pollution sensing platforms

- Sensing campaign configuration over **slice** and **in-field calibration AI**
- Connection density of more than 400 sensors per km^2
- Large volume of data generated by Hyperspectral and LIDAR camera
- Accurate 3D location
- Energy efficient communication



Builds on: Station for Measuring Earth Surface-Atmosphere Relations (SMEAR)
https://www.atm.helsinki.fi/SMEAR/

Enabling Massive Air Pollution Sensing Using 5G

Requirements	Solutions
Air Quality Sensors	Sensing as a Slice
High Connection Density	mMTC
Big Data Volume	eMBB
Location Information	5G Antennas
Optimized Power Consumption	Energy Efficient Communications

Near real-time high-res air quality map
Green path navigation

JOIN THE MEGASENSE INNOVATION NETWORK

CONTACT
WWW.HELSINKI.FI/MEGASENSE

CO-OPERATION WITH

CHINA MOBILE 5G INNOVATION CENTER / NOKIA CORPORATION / NAVINFO / ELISA / SMEAR LTD / VAISALA / 5G TEST NETWORK IN FINLAND / CITY OF HELSINKI / FINNISH METEOROLOCIAL INSTITUTE /

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