

Indoor positioning

How it can be done and why it matters

Aalto 16.11.2020



Agenda

Steerpath in a nutshell

Indoor positioning technologies and methods available

Indoor positioning as part of intelligent buildings

Practical use of indoor positioning

Case examples

Evolution of Steerpath Solution

Changi Airport Singapore
**World's leading
indoor wayfinding
solution**

Aalto University Real Estate
**Real Time Space
availability & maps
for entire campus**

Senate Properties
**Cross use of
spaces for 169
organisations**



Wayfinding
2016-2018

Space availability
2019

Space booking
2020

Hybrid work
2021

Categories of Indoor Positioning systems (IPS)

Network centric (Tracking)

- Location calculated in cloud (typically)
- Tracked does not know they are tracked or their location (exception exists)
- Wired, networked infrastructure
- Used for security, material flows, logistics

In-device positioning (GPS like)

- Location calculated in device
- Location often used in the device to provide a service (wayfinding, collision detection, geo-fencing)
- Can work without networked infrastructure, even without infra
- User for location based services
- **Can roam between indoor & outdoor environments**

Bluetooth Infrastructure

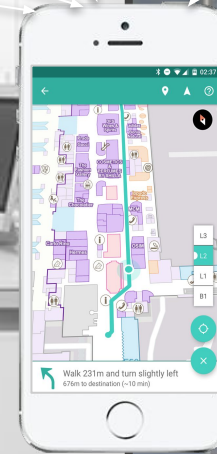
GPS Satellites

Seamless transition from outdoor to indoor

Routing works between buildings

No network connectivity or power required

Installation happens in a matter of hours



IPS technologies

	Network centric	In-device
Radio	Asset tracking (hospitals, industrial)	Location based services (Smart office, wayfinding), security
Visual / Camera	People counting, behavior analytics, security	AR games & Apps
Inertial / Odometry	N/A	Robots & Autonomous vehicles

Types of radio based IPS

UWB

WiFi

Bluetooth

5G

Others (Ultrasound, Hybrid positioning systems, Zigbee, proprietary radios)

Radio based IPS - positioning methods

Time of Flight (ToF) based trilateration

Summary

- Approximates distance between transmitter and receiver based on signal delay

Used by

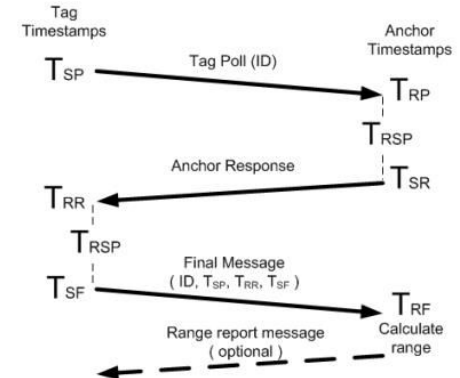
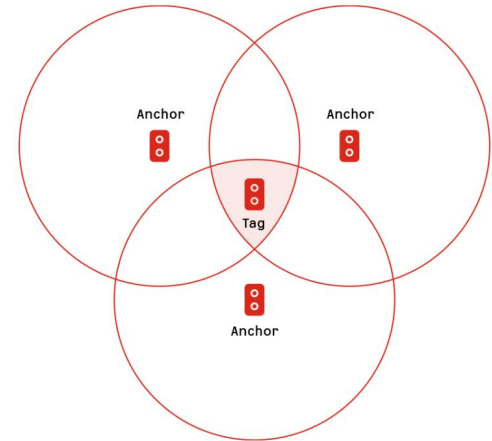
- UWB, 5G, WiFi (special solutions), Ultrasound (not radio though)

Pros

- Pretty tolerant for multipath propagation
- Can be very accurate, down to 10cm
- Somewhat tolerant against multipath propagation

Cons

- Often expensive and requires active, powered infrastructure



Angle of Arrival / Departure (AoA/AoD/AoX) based triangulation

Summary

- **AoA:** Multiantenna receiver calculates angle of which the signal from single antenna transmitter arrived with. Combining multiple reference points (2 or more) location can be determined
- **AoD:** Multiantenna transmitter sends signal through its antenna array. By knowing the antenna characteristics of the transmitter, a single antenna receiver can calculate the transmitter direction.

Used by

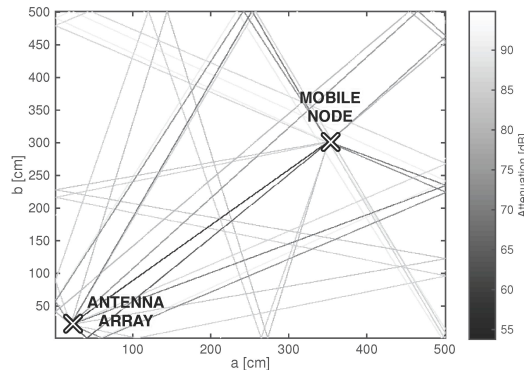
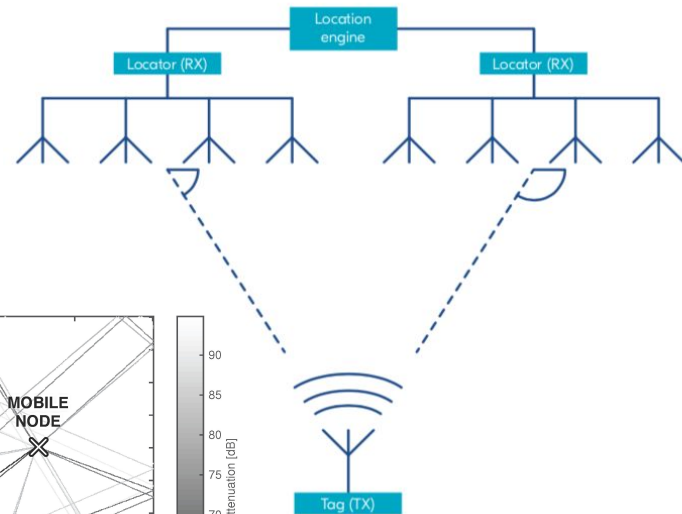
- Bluetooth 5.1, 5G

Pros

- Can be very accurate, down to 10-30cm
- Works well in large open areas

Cons

- Very sensitive to multipath propagation
- Installation time consuming
- Not supported by phones (at least yet)



AoA example

Received Signal Strength (RSS) based trilateration

Summary

- Approximates distance between transmitter and receiver based on signal attenuation

Used by

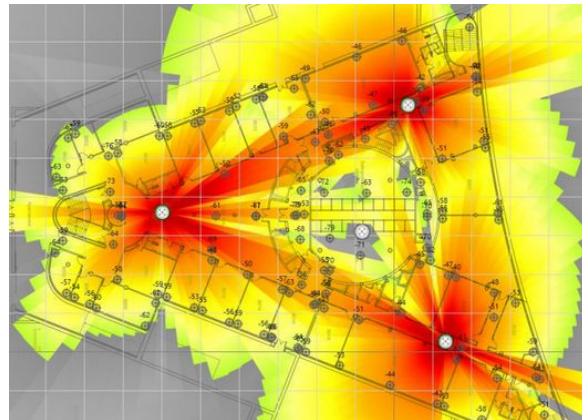
- Bluetooth, WiFi

Pros

- Cost efficient - almost all receivers have RSS indication
- Very cost efficient (5-50x lower cost than ToF & AoX)
- Can work on battery operated infrastructure - cost efficient both HW and installation
- **Works with mobile phones**

Cons

- Accuracy decreases quickly over distances
- Very sensitive to multipath propagation (happens always indoors) and obstacles

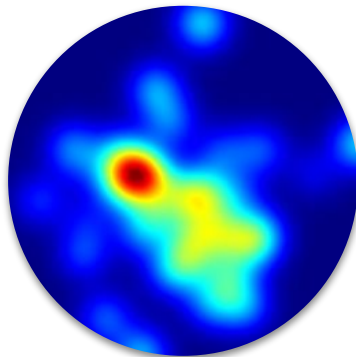


IPS is just an enabler

In order to get real life value, it needs to be combined with other data sources



Map data / Digital twin
context & visualisation



Indoor Positioning
User / Asset location



Wayfinding & routing
Distance and time estimates

IPS as part of intelligent buildings

STEERPATH APPS

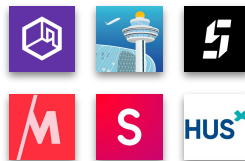


SMART CAMPUS



SMART OFFICE

INHOUSE APPS

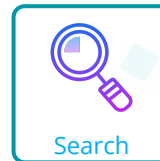
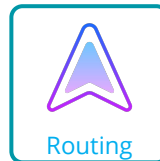


ECOSYSTEM PARTNER APPS



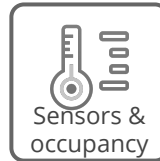
Web, iOS and Android SDKs

STEERPATH PLATFORM



Open REST API

EXISTING MASTER DATA



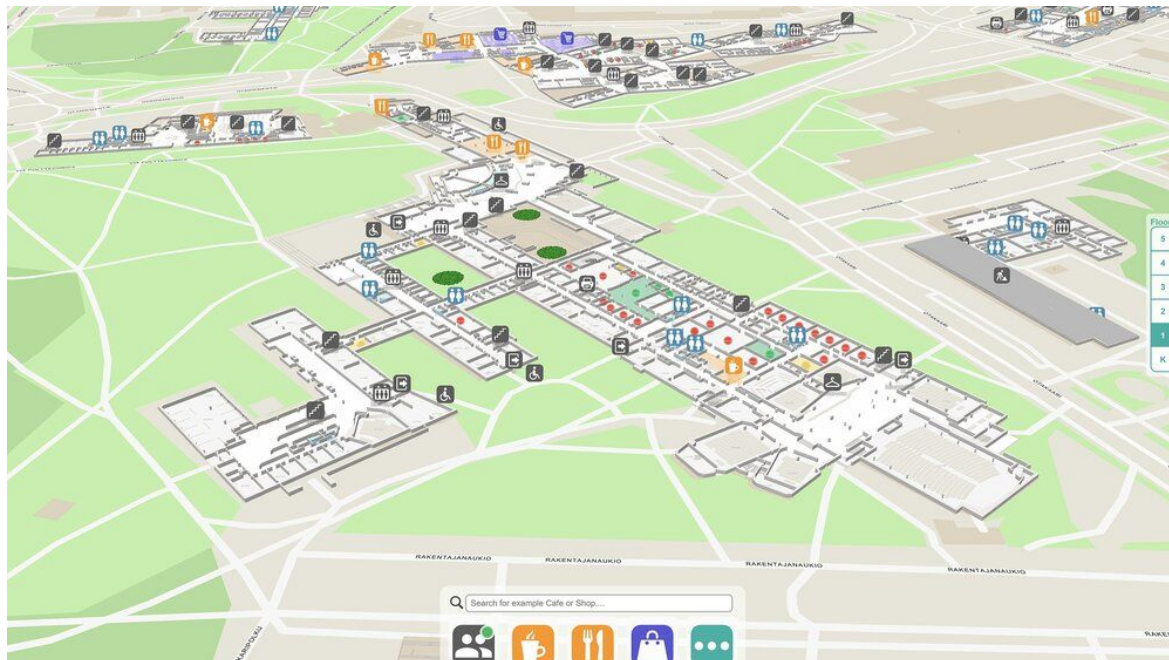
PLATFORM COMPONENTS

MAPS & DIGITAL TWIN

Not just an image!

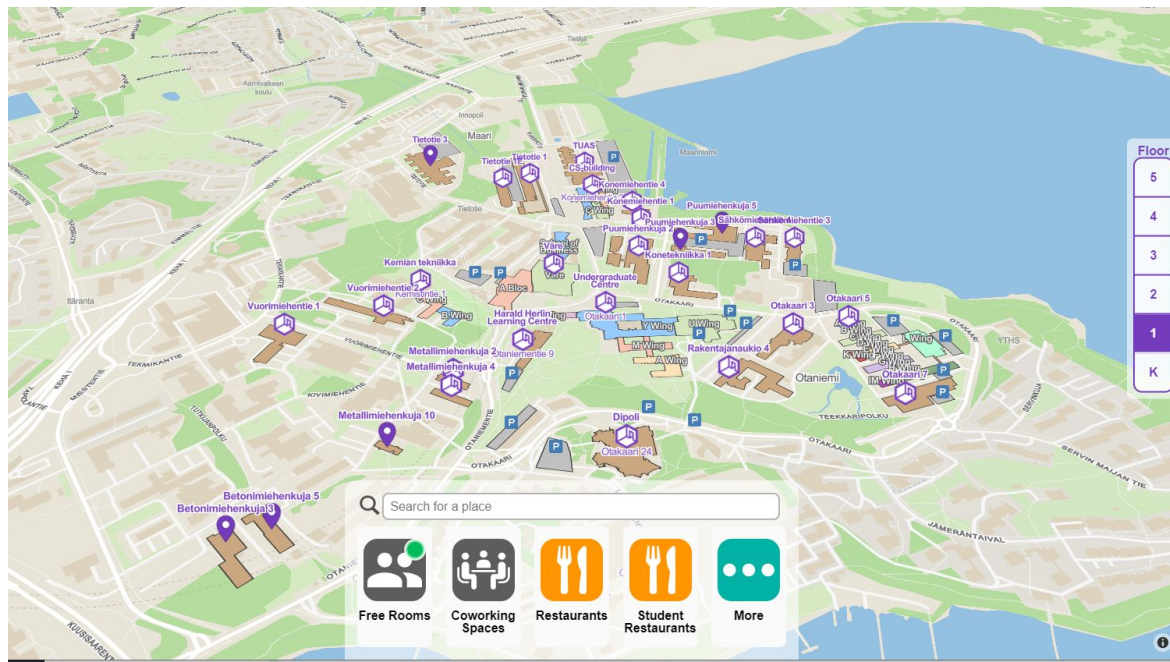
Structural data (walls and room geometries, etc.)

Real time sensor information (Occupancy, temperature, reservation)



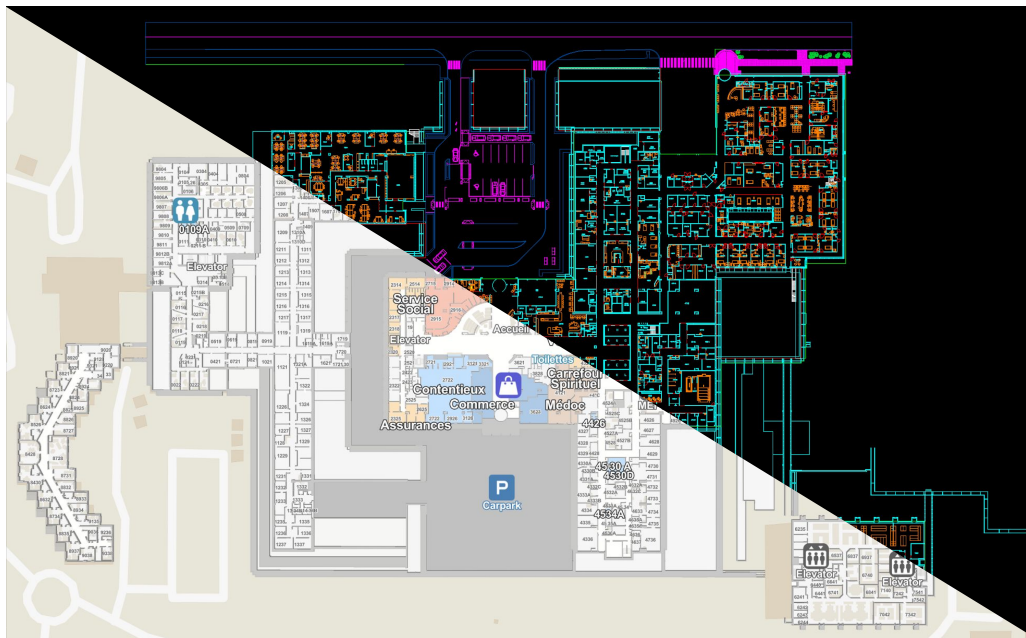
GLOBAL INDOOR DATA

Using WGS84 (Lat, Lon) for indoors allows seamless experience for data visualisation but also allows comparable data sets



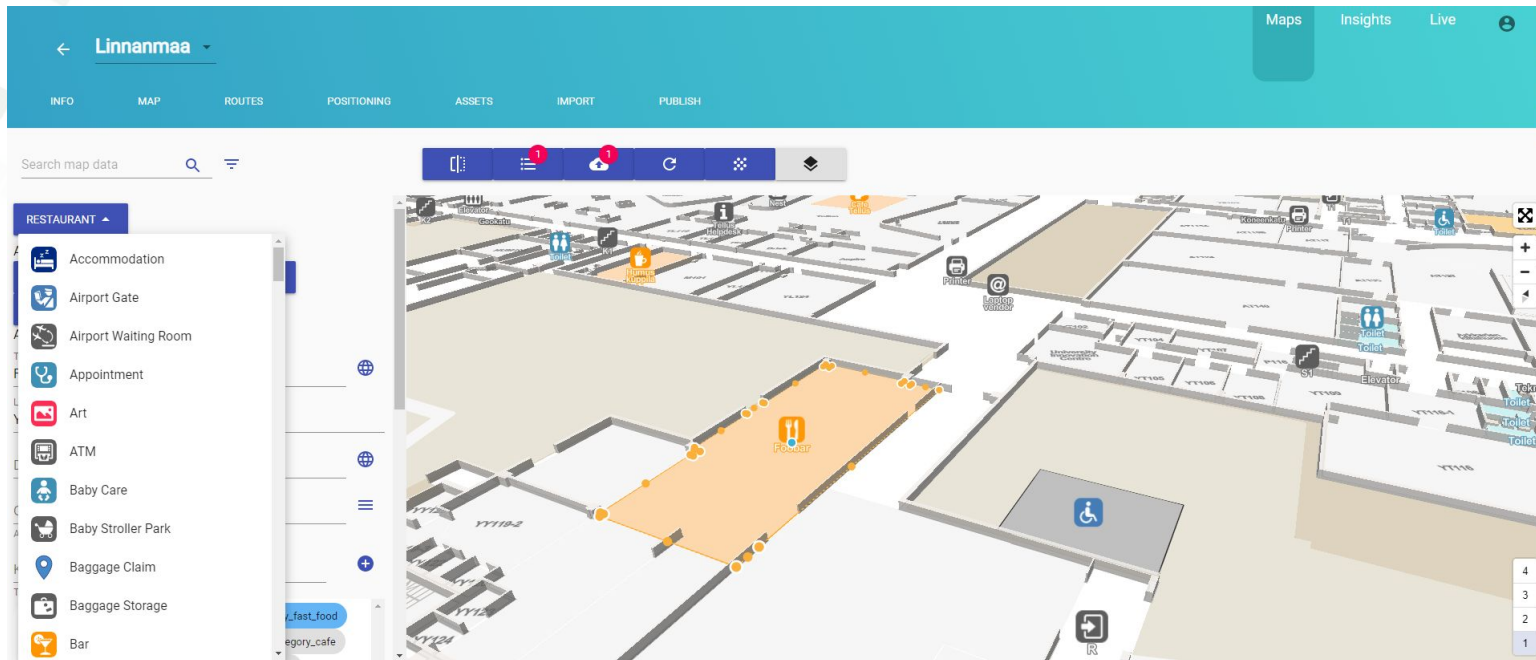
Facility management: BASE MAP

Base data from AutoCAD to ensure accurate geometries.
This is particularly important when overlaying indoor positioning data!



Operations team: MAP MANAGEMENT

Easy to use self-service tools important so that data is kept up to date





IPS ENABLED USE CASES & APPS

SMART CAMPUS

Multi-screen Web App for visitor guidance



Home - Invite arrives

Hello John Doe,

You are invited to a meeting at Steerpath Campus, Meeting room A124c.

[Please click here to open the map.](#)



Self-registration

User selects where they want to go and gets step by step instructions which they can take with them using a simple QR code.

QR code



Use navigation through browser or application with real time indoor positioning.

Share destinations and locations easily with colleagues and friends.

At home

On arrival

<Customer journey continues through other smart building solutions>

GEOSPATIAL ANALYTICS

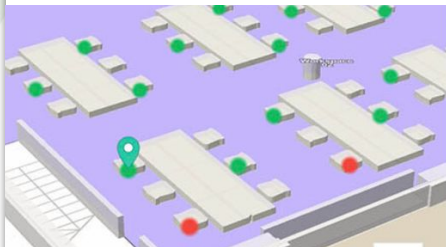
Visualising sensor data and user behavior analytics
to make them more tangible



Smart Office 2.0

Hybrid work: One app for booking both office and remote spaces

Own offices



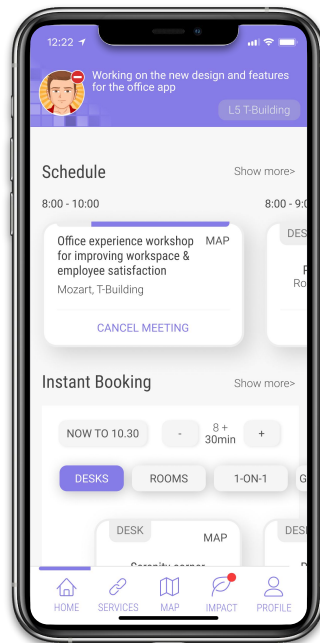
Space efficiency

Employee experience

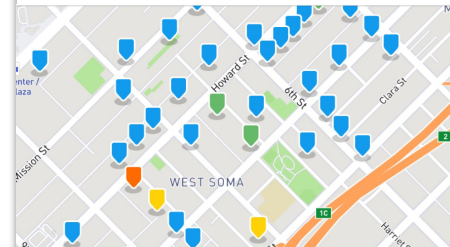
Predictive occupancy
analytics

Desk & Room booking
Outlook & Google integrations

App



On demand



Use all corporate offices
freely

Meet outside of the office
with customers and
colleagues

→ support work anywhere &
open collaboration

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An aerial night-time photograph of Changi Airport. On the left, a tall, slender control tower with a multi-tiered observation deck is illuminated. To its right is a large, modern terminal building with a distinctive glass and steel dome structure. The foreground is filled with lush green trees and a road with light trails from cars. In the background, other airport buildings and a small airplane in the sky are visible.

CHANGI AIRPORT

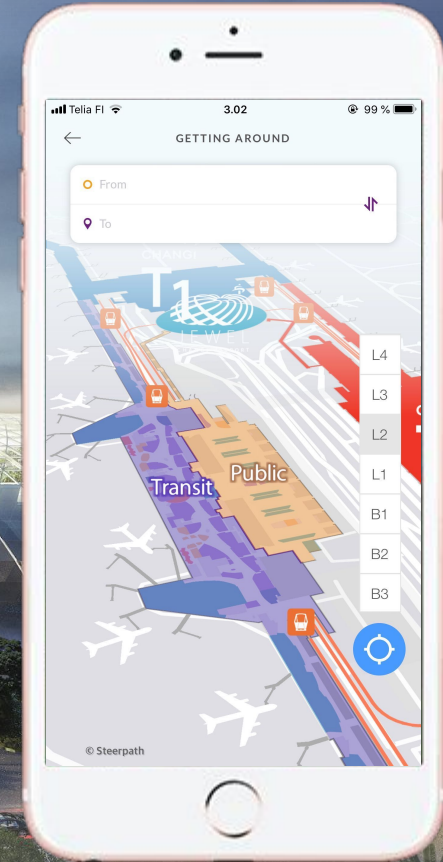
Helping travellers navigate
fluently since 2017

iChangi App & changiairport.com

- Indoor positioning and maps for all 4 terminals
 - Almost 1 000 000m2
- Live since 2017
- Over Millions App downloads, > 50k MAU
- Used for:
 - Passenger apps (wayfinding)
 - Airport website (wayfinding)
 - Operational apps & solutions
 - Chatbot (map metadata)
- Real time positioning with accuracy of 5m, using Bluetooth beacons.
- Smart search
- Estimated walking time to gates

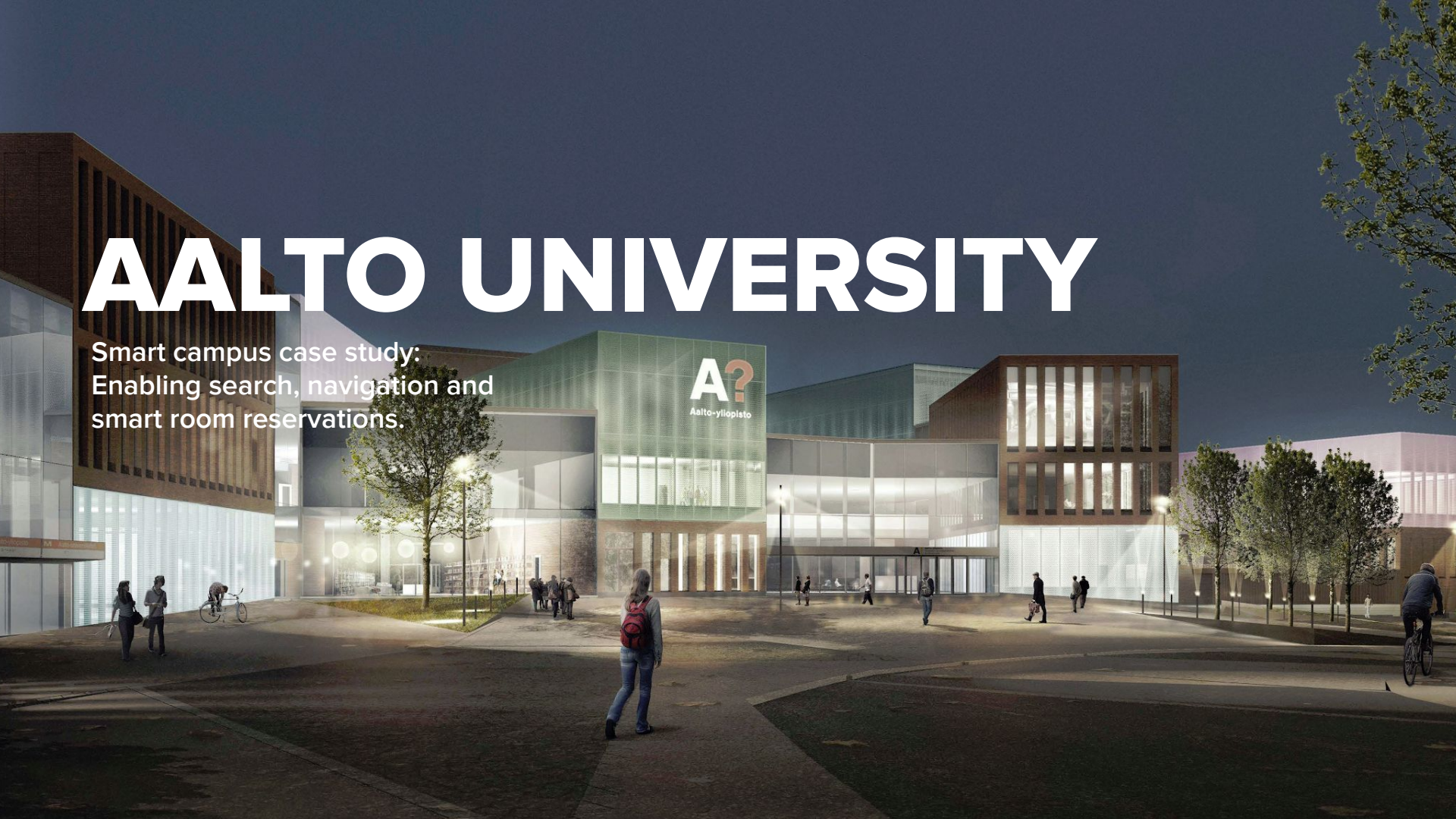
Test it: <http://bit.ly/changimap>

Video: bit.ly/changi-steerpath



AALTO UNIVERSITY

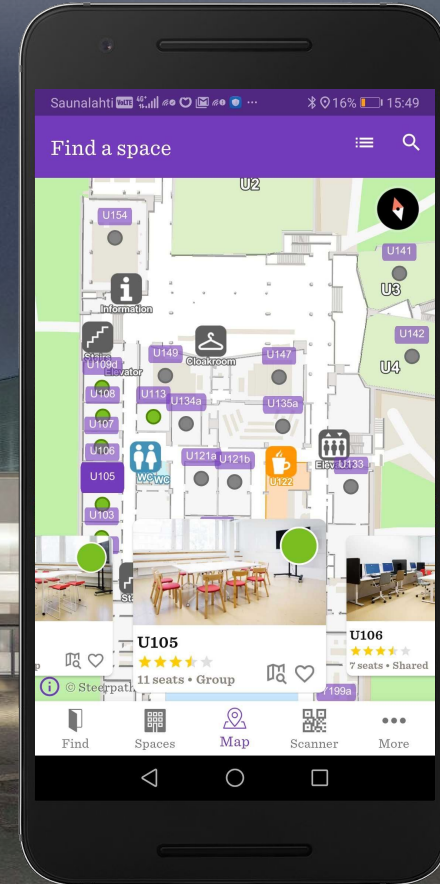
Smart campus case study:
Enabling search, navigation and
smart room reservations.



Aalto Campus App

- Web and mobile app for the #1 uni in Finland
- Wayfinding that works campus-wide and seamlessly between buildings.
- Search and wayfinding to any POI.
- Sharing a link or QR code of any POI
- Positioning available in 20 campus buildings, 300,000 m2 of indoor space covered.
- Has reached over 80% of potential users
 - 15 000+ downloads
 - 5000 MAU
 - 400 bookable rooms
- Mobile application for adhoc room booking
 - Students
 - University staff
 - Campus tenant companies
 - Visitors

Test it: <http://bit.ly/aalto-123>



OULU UNIVERSITY

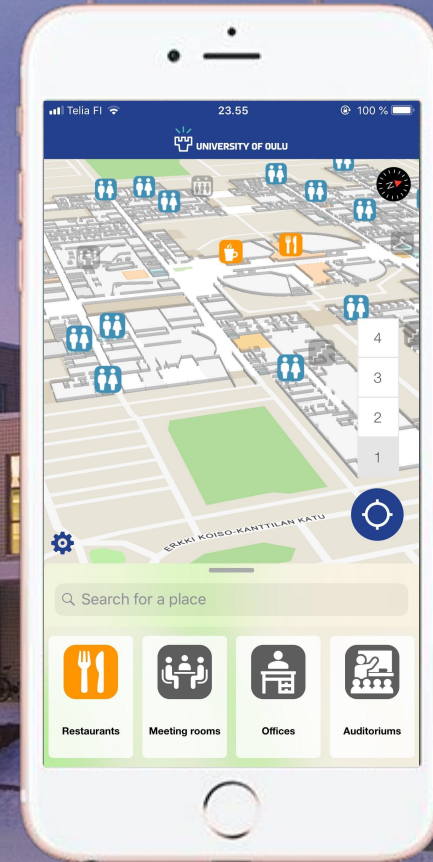
Student and visitor guidance in the largest campus of
Northern Scandinavia



Oulu University campus app

- Mobile application, web app and interactive pylons for finding spaces for
 - Students
 - University staff
 - Campus tenant company employees
 - Visitors
- Works campus wide and seamlessly between buildings
- 150,000 m2 of indoor space covered
- Deployment done in 5 days by 2 people, including 1,500 Bluetooth beacons installation.

Test it: <http://bit.ly/campus123>



A modern office lounge with a grey sofa, orange armchairs, and a round table. Several people are sitting on the sofa, some using laptops. The room has large windows, a staircase in the background, and decorative pendant lights. A glass partition on the right has the text 'LUOTSI Neuvotteluhuone' on it.

SENATE PROPERTIES

Case study of the largest real estate owner in Finland:
Delivering on the promise of flexible spaces,
Free spaces visible on kiosk and mobile app

Senate Properties

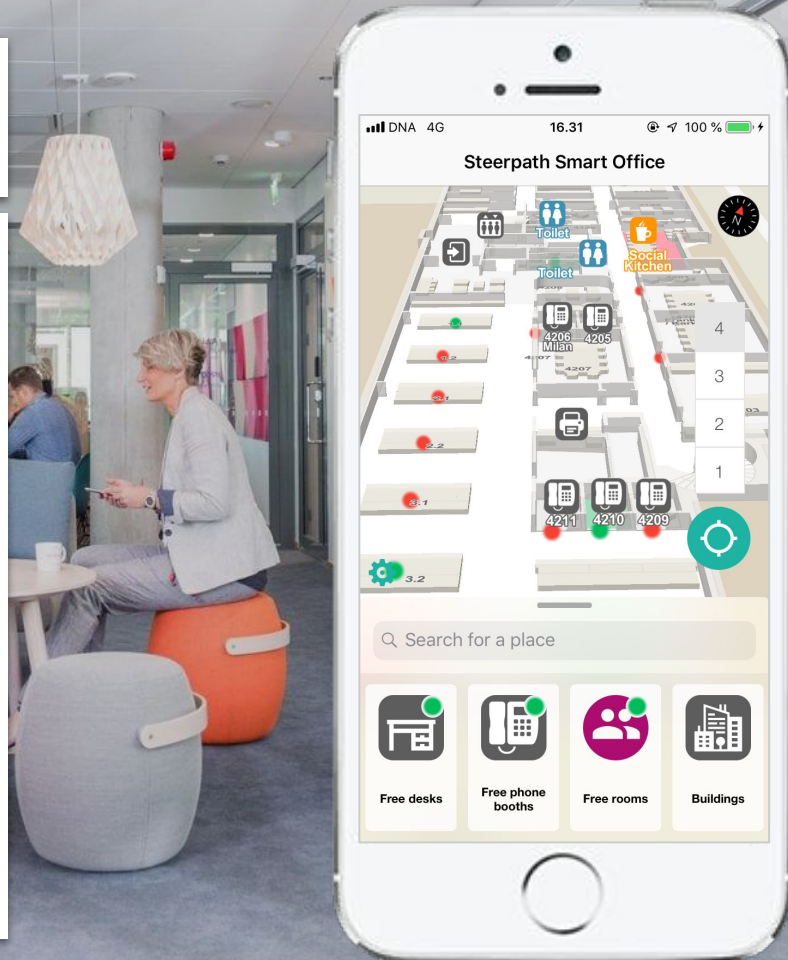
Senate Properties, the **largest real estate owner in Finland**, is co-operating with Steerpath in creating the **ultimate office application** for modern working environments.

The solution is in use at Senaatti Properties Headquarters in Helsinki.

App integrates with users calendar and knows where the next meeting is and when asked, guides the users to the meeting.

Real time meeting room reservation on mobile and kiosk

Closest free space with one click, both on mobile and kiosk screen.



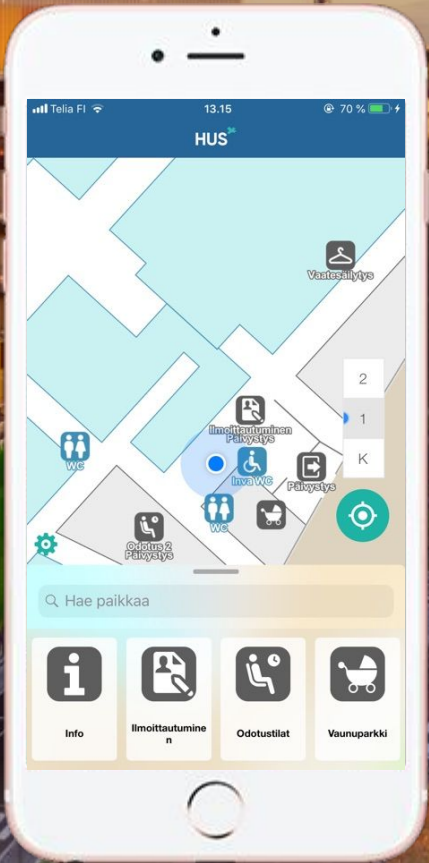
CHILDREN'S HOSPITAL

Lower stress & less staff interruptions with patient wayfinding
Helsinki, Finland



New Children's hospital

- Mobile application for finding spaces for
 - Waiting areas
 - Parking places
 - Next appointment
- Installation done in one day
- Ready to be extended for the surrounding campus
- Info kiosk support
- Deep link support
 - Directly opens POI based on link on a email invite or from reading QR code
 - Navigation can “jump” from info kiosk to mobile app



Thank you!

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