Dynamic Wi-Fi Reference Point Recognition along Public Transport Routes

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Introduction

Addressed Problem

User Localization in urban environments

using Wi-Fi location fingerprinting method on the outdoor and combination of indoor and outdoor environments.

Importance of problem

Enhance User Preferences and Experiences
by handling the optimal routing and localization computation on duration and other parameters in multimode transportation

Determine Location in Urban Environment
especially when determining user current location where GNSS signal is unreachable or become obscure under urban environment

#2 Method

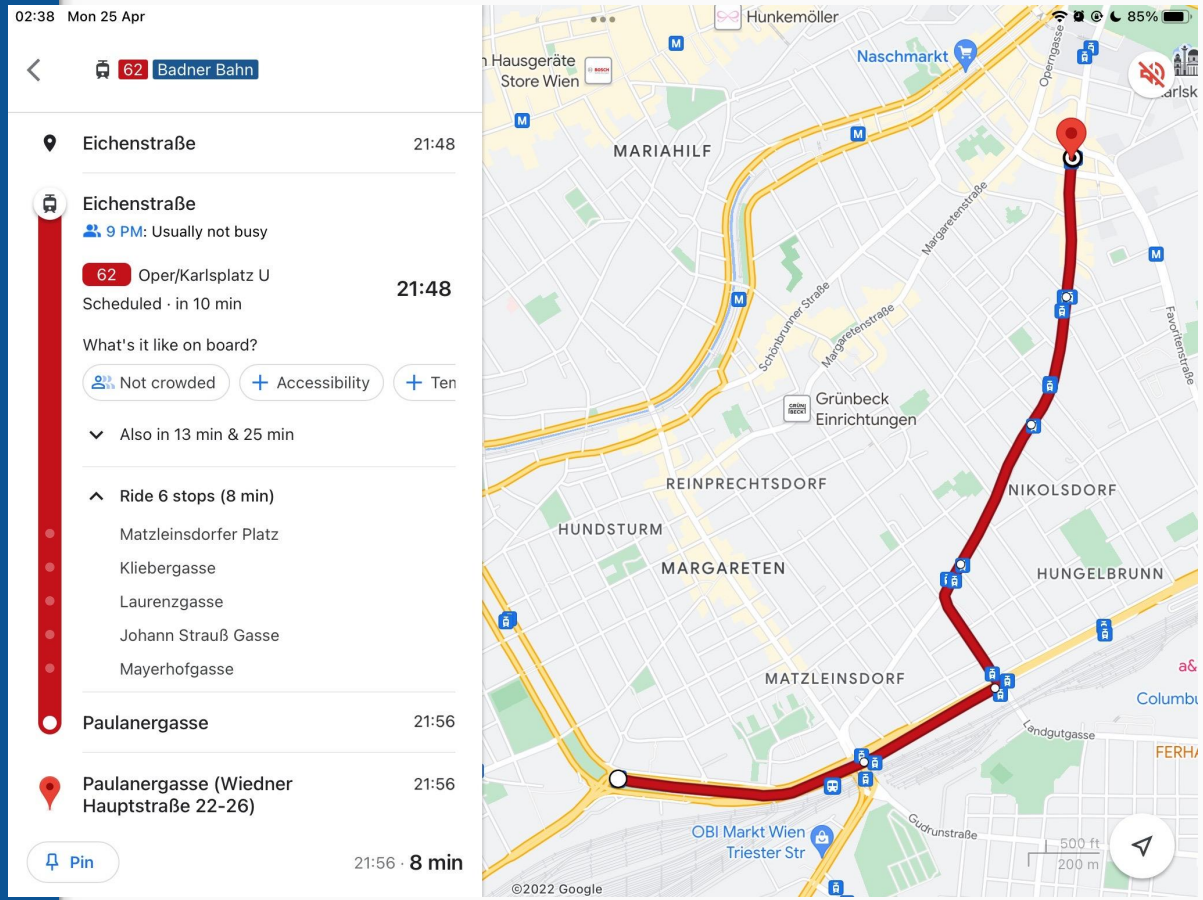
Designed Scenario

Vienna Public Transport System

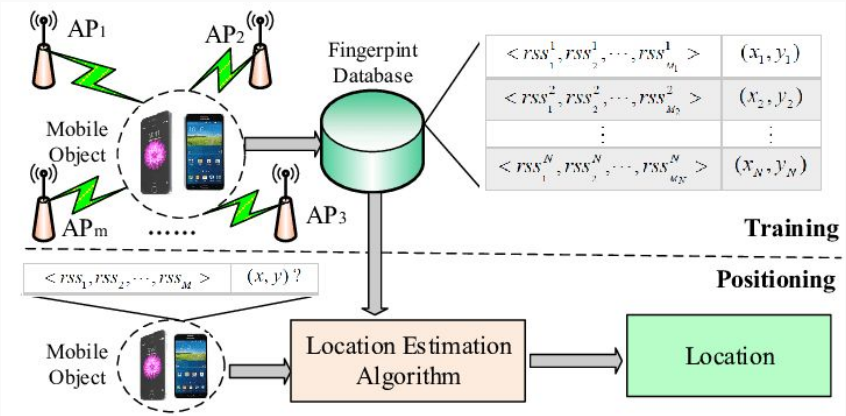
Focusing on the tram/light rail transit route number 62, from Oper/Karlsplatz to Lainz Wolkersbergenstraße

Selected tram journey:
Eichenstrasse - Paulanergasse

Designed Scenario (cont.)



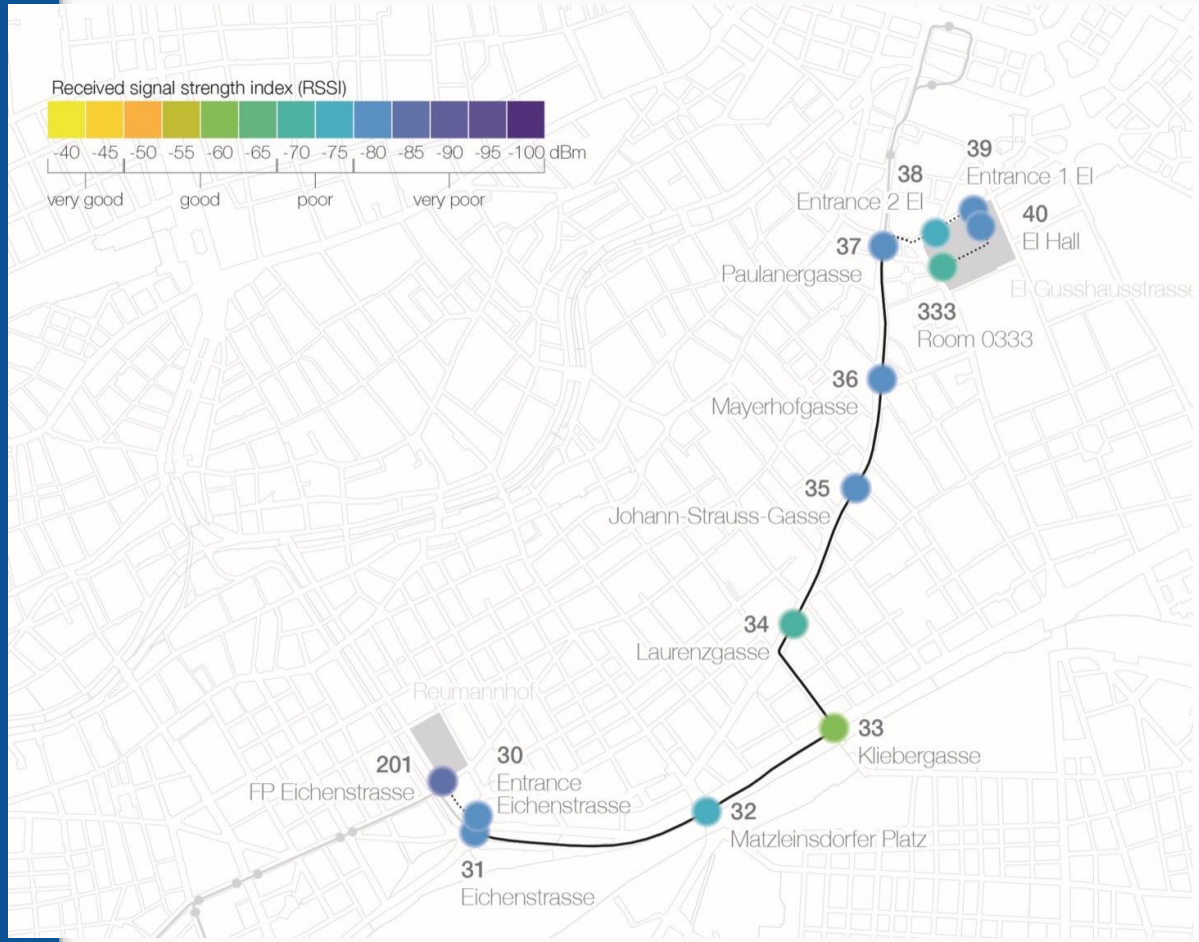
Software & Tools



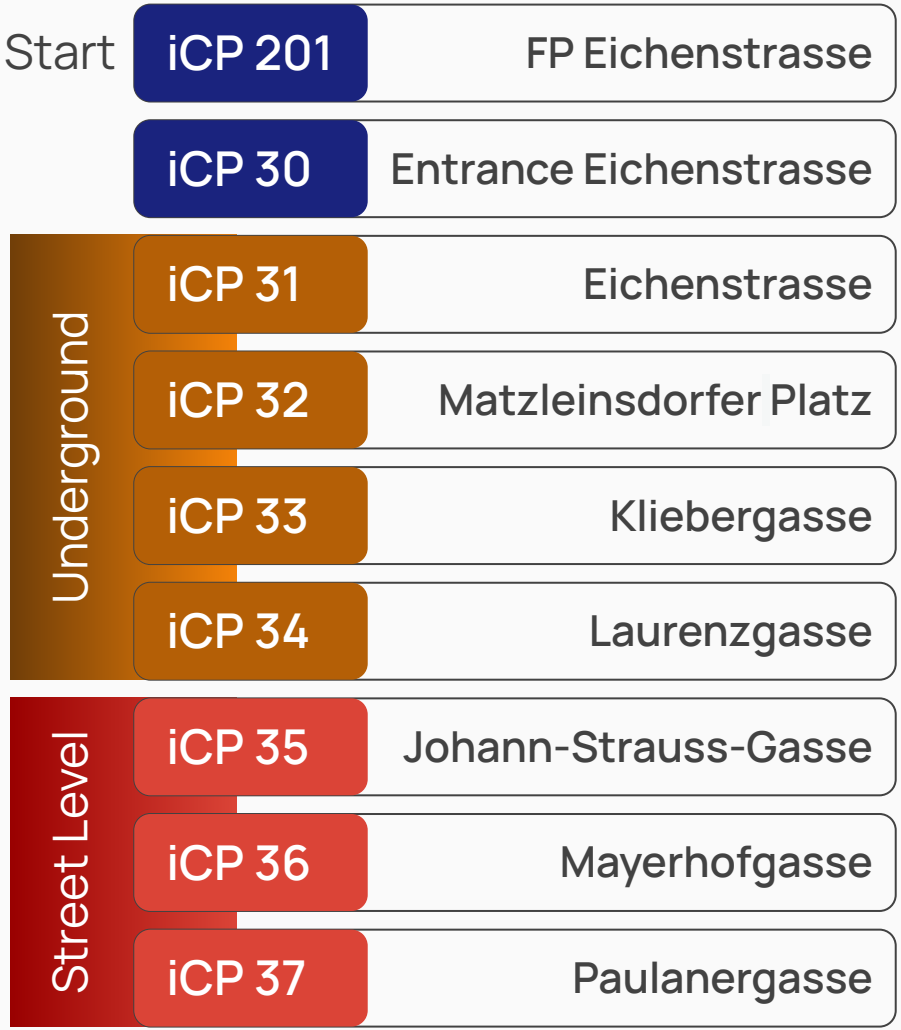
Wi-Fi Location Fingerprint

Finding a location of a person based on RSSI and AP count of Wi-Fi networks, measured at reference point referred as Intelligent Check Points (iCPs) throughout the journey.

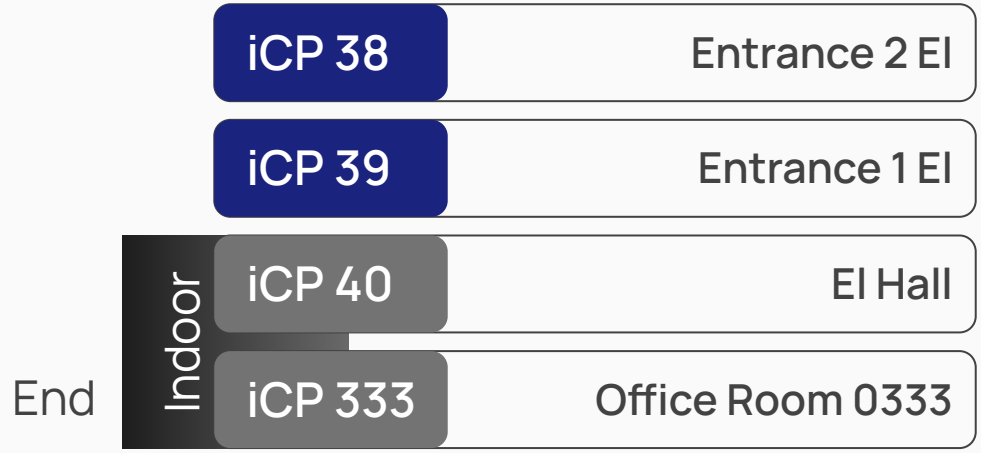
Intelligent Check Points (iCPs)



Intelligent Check Points (iCPs) (cont.)



Intelligent Check Points (iCPs) (cont.)



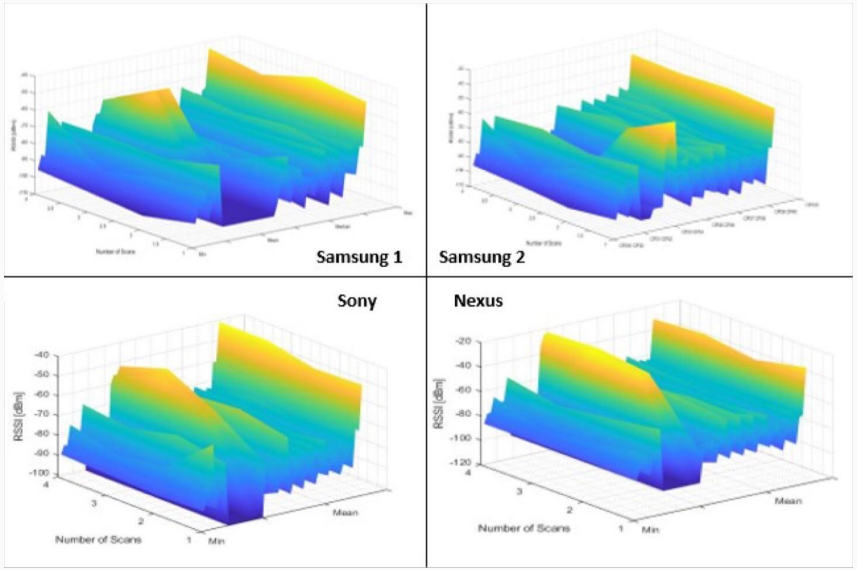
Travel time: approximately 15~20 minutes.
On-board Wi-Fi trains are selected.

Software & Tools (cont.)

Smartphones

- Samsung Galaxy S3
- LG Nexus 5X
- Sony Xperia Z3

Focused Data



At each iCP,

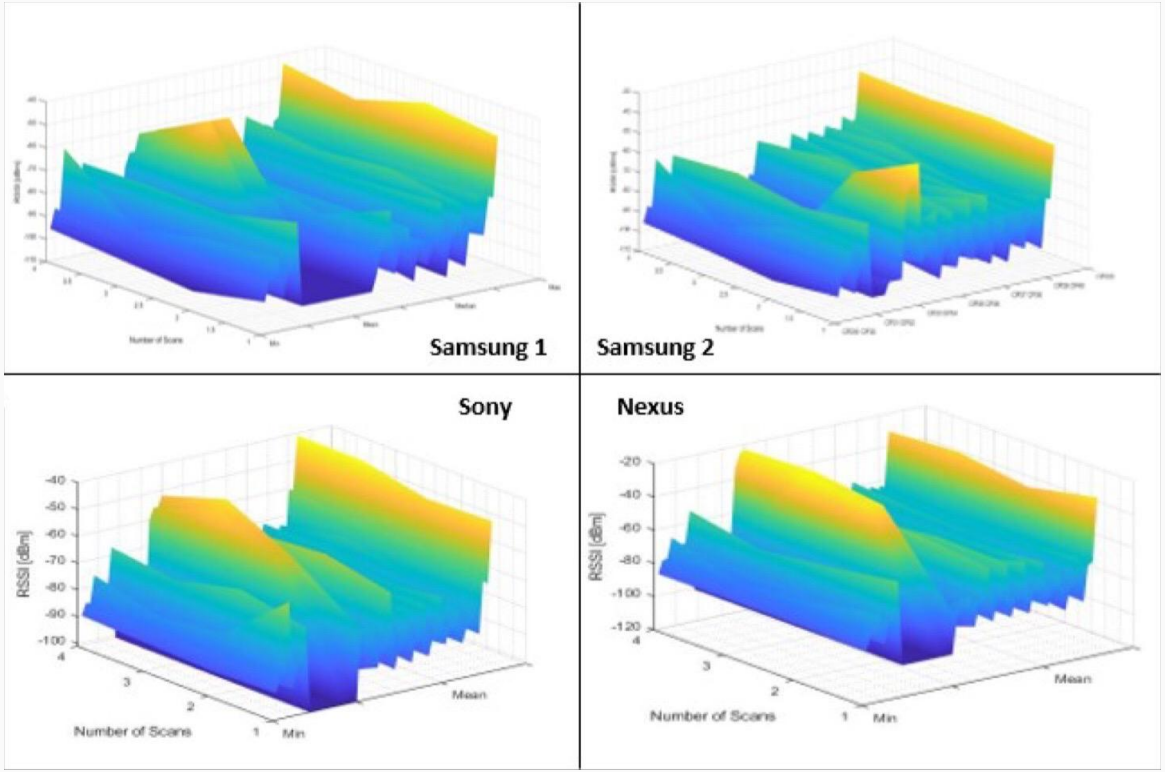
- Wi-Fi access points (APs) count
- Received Signal Strength Index (RSSI)

#3 Result & Discussion

Discussion

Wi-Fi APs: RSSI value

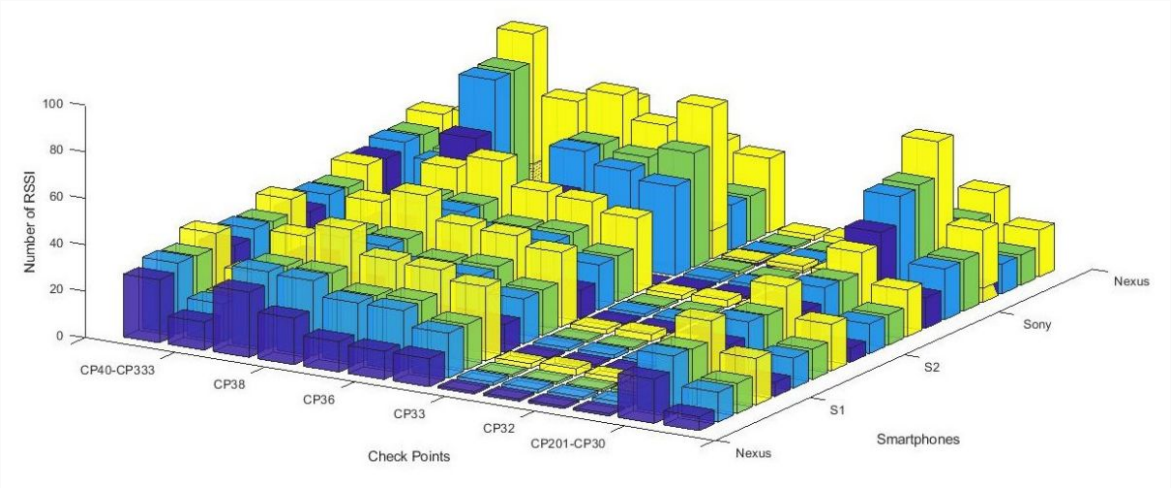
The environment has the higher influence on RSSI value rather than phone's specifications as clearly seen on tunnel section.



Discussion

Wi-Fi APs: APs Count

The number of APs are dropped significantly in the underground section, due to less underground Wi-Fi coverages, block of overground Wi-Fi signals by tunnel wall.

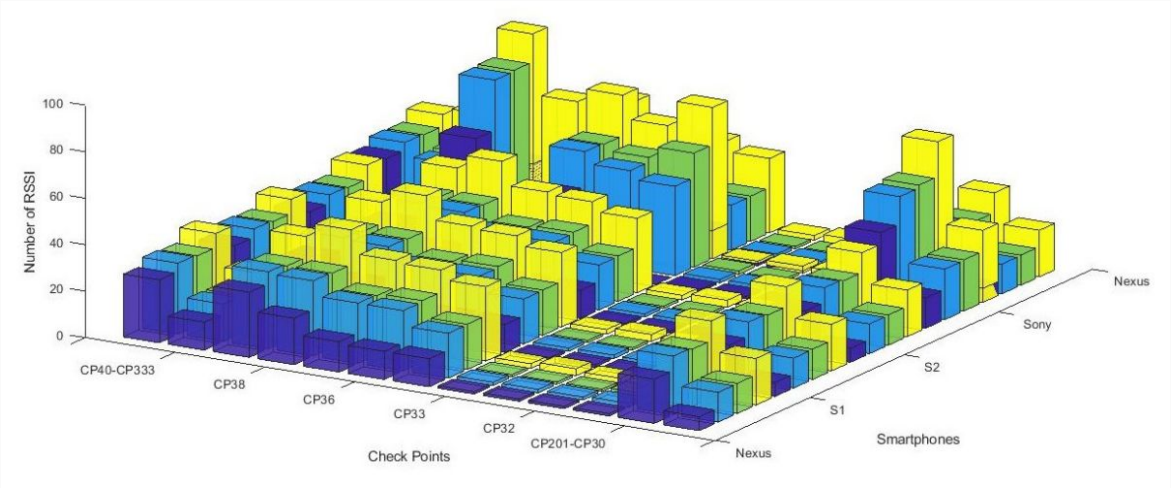


Discussion

Wi-Fi APs: Smartphone

Battery life, phone case, measurement location has the impact on APs count.

LG Nexus has better receiver for picking up Wi-Fi networks, providing the best tool for accurate Wi-Fi fingerprinting.

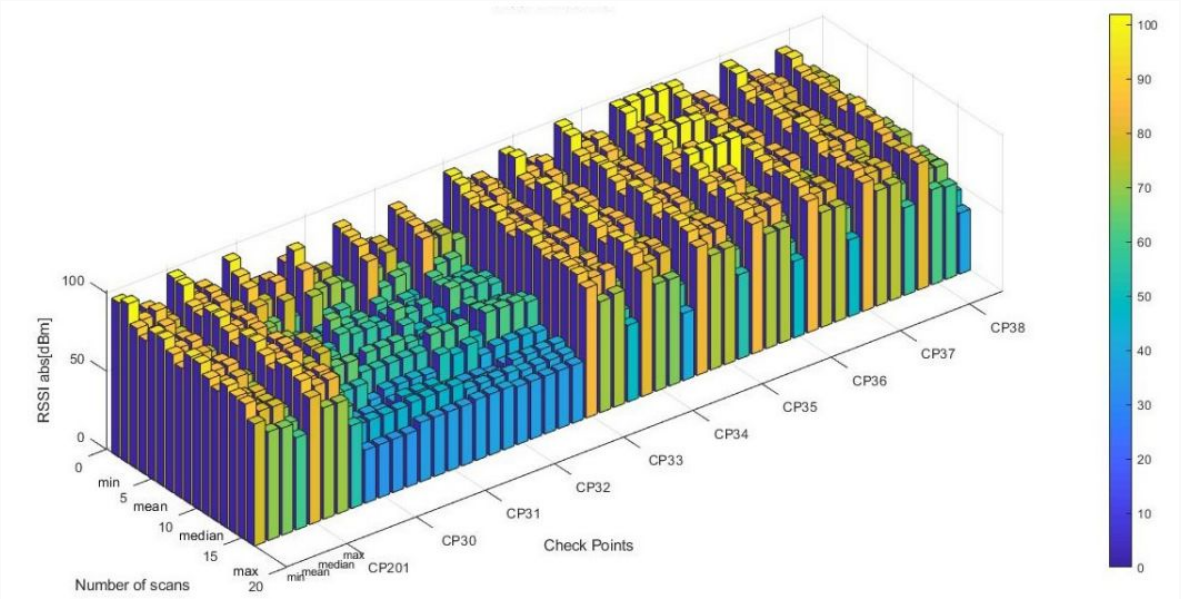


Discussion

RSSI Variation at iCPs

The strongest signal is at iCP37 where higher number of hotspots or larger number of APs in building nearby.

The weakest signal is at underground section.

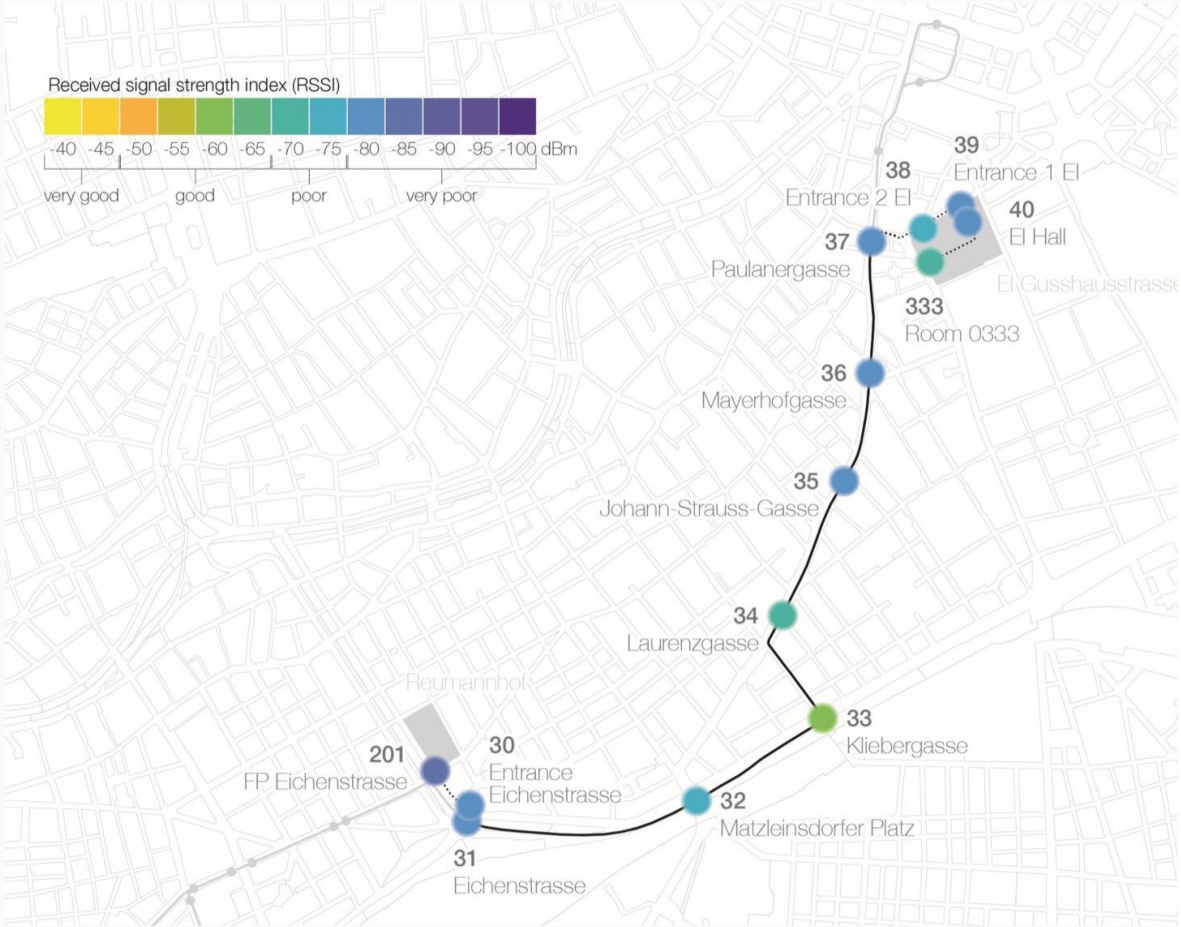


Discussion

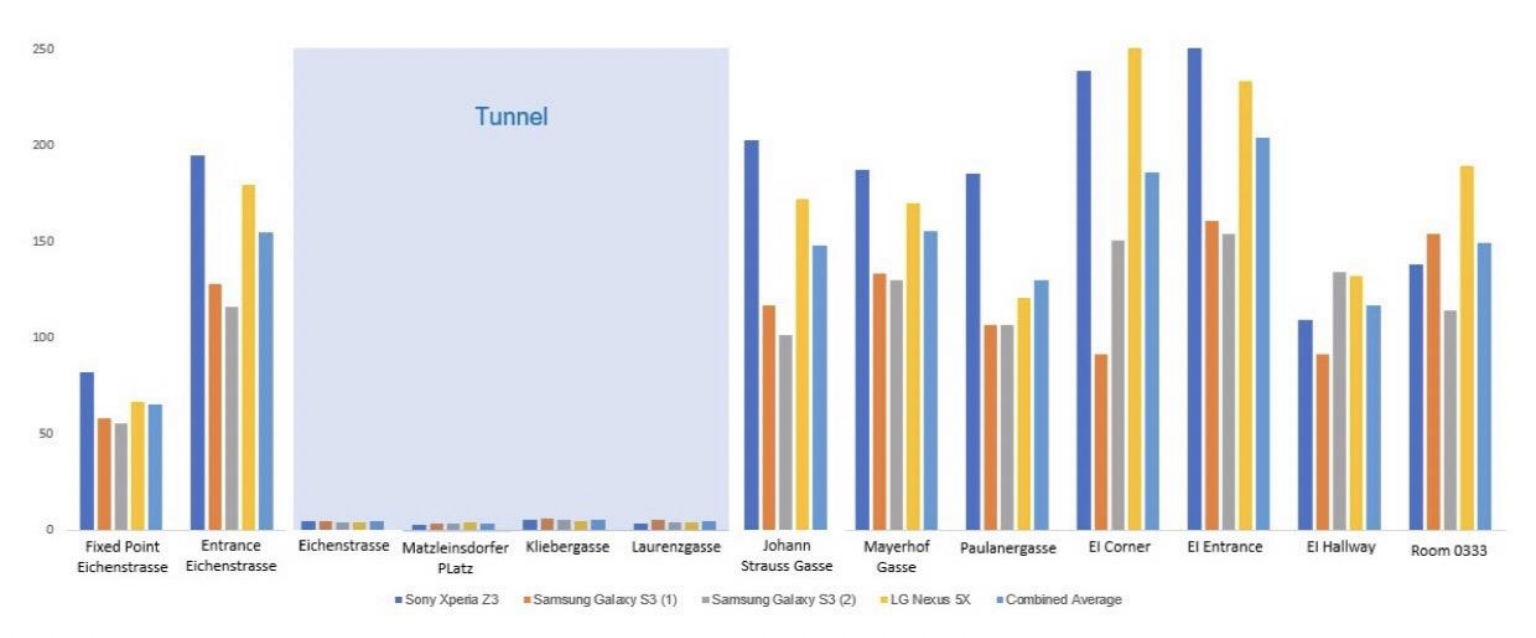
APs Count and RSSI Comparison

Highest RSSI values is at the underground section.

Inside the building has the lowest recorded value.



Discussion

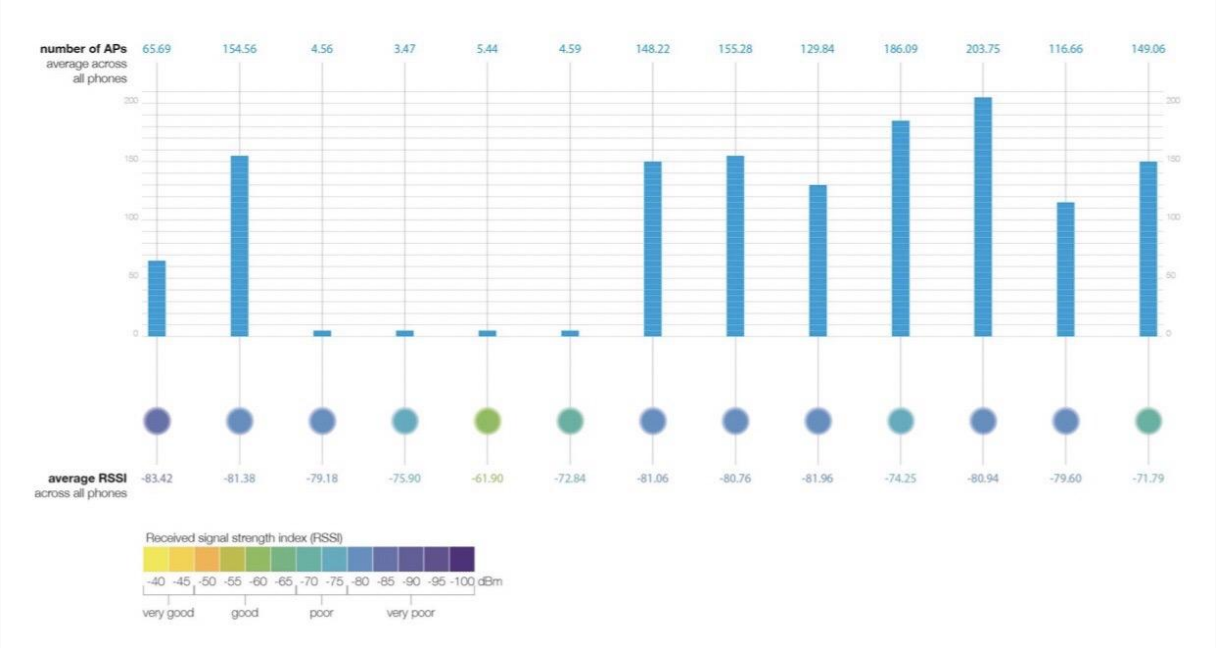


APs Count and RSSI Comparison

Less number of APs are collected inside underground section.

→ **The RSSI value and AP count are not positively correlated.**

Discussion



APs Count and RSSI Comparison

The number of RSSI value and APs count are visibly change in the street level.

→ **Underground section has good RSSI value but low APs count.**

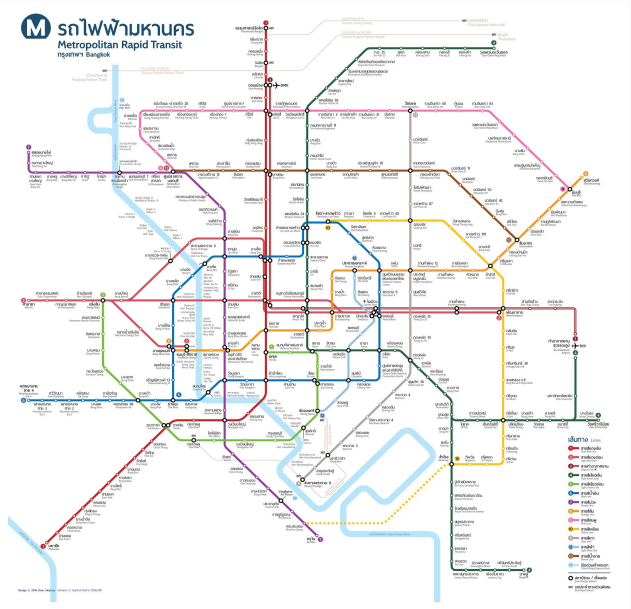
Outcome

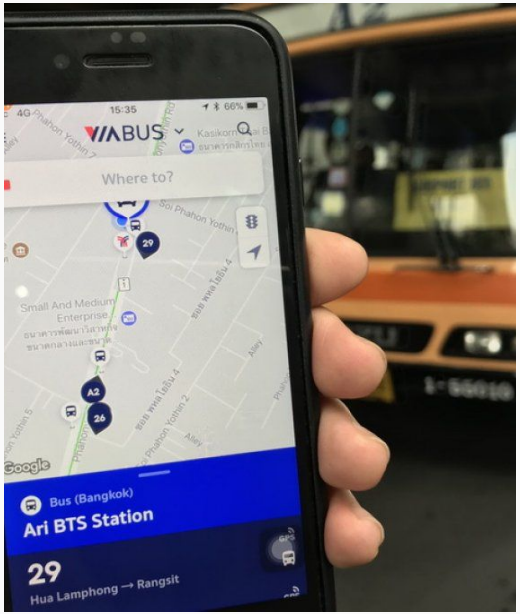
- High variability in RSSI value throughout the route.
- Buildings and infrastructure, phone's orientation, and phone's specifications has significant impact on RSSI value.
- From underground section, RSSI value is high but less APs are detected.
- **Wi-Fi fingerprinting at iCPs are distinguishable from one another.**
- **iCP recognition accuracy and reliability can be improved by taken a larger number of measurement over large periods of time.**
- Future research can be conducted using more smartphone model, larger checkpoints coverage, and longer duration.

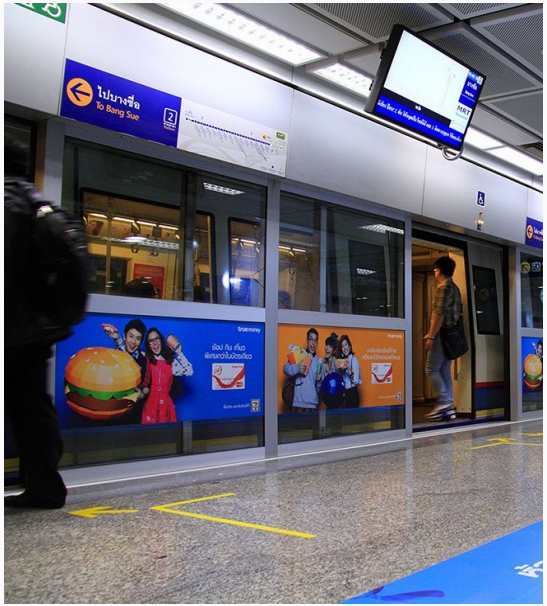
Stakeholders

Users of Vienna public transit system

Future Implementation







Thank you for your attention.

Reference:
Retscher, G., Bekenova, A., Fazliu, A., Hallett, M., Harvey, L., & Janssen, J. (2019). Dynamic Wi-Fi Reference Point Recognition along Public Transport Routes. *In LBS 2019; Adjunct Proceedings of the 15th International Conference on Location-Based Services / Gartner, Georg; Huang, Haosheng*. Wien. https://doi.org/10.34726/lbs2019.26

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