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Catching the Right Bus

Improvement of Vehicle Communication with Bluetooth Low Energy for Visually Impaired and Blind People

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Catching the right bus

https://commons.wikimedia.org/wiki/File:Weld_Quay_Bus_Terminal_02.jpg

Visually impaired and Blind people rely on public transport

The Problem

- Visually impaired and Blind people rely on public transport!
- Subway or Tram
  - Accurate Timing
  - Specific order “Line 15 comes always after Line 7”
- Problem with Busses
  - crowded bus station
  - different companies
  - Different departure time

The Problem

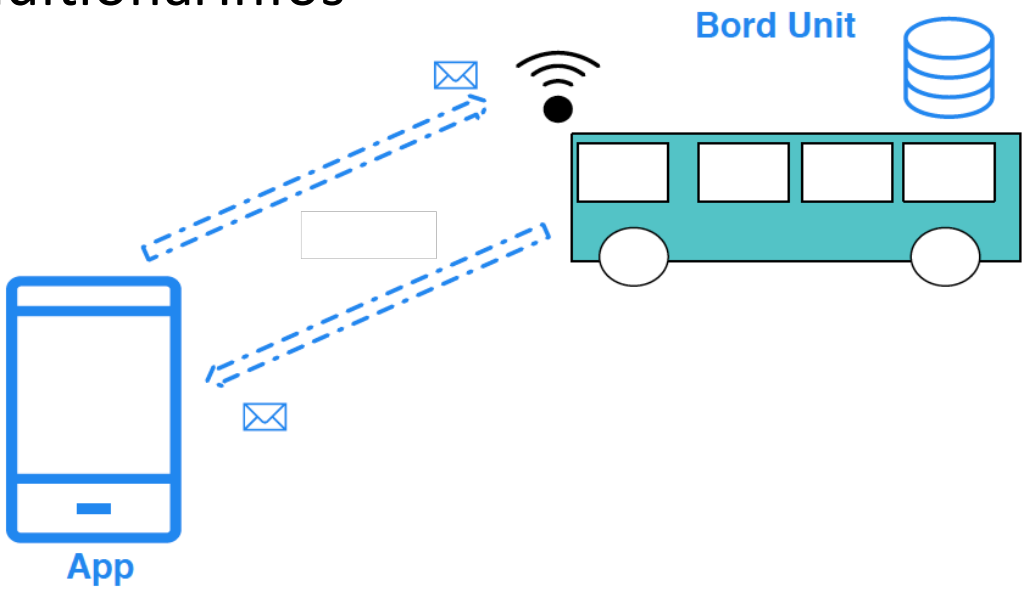
- Special problem: Bus stop for several bus lines
  - Vehicle stops only once
  - No definitive order of arrival

Possible Solutions

- Bus is always on the same position
  - Not working !
- Go to the right bus
  - e.g. request audio signal form the vehicle
- Go to the right bus and notify the vehicle
  - Bi-directional communication between vehicle and user

Bi-directional vehicle Communication

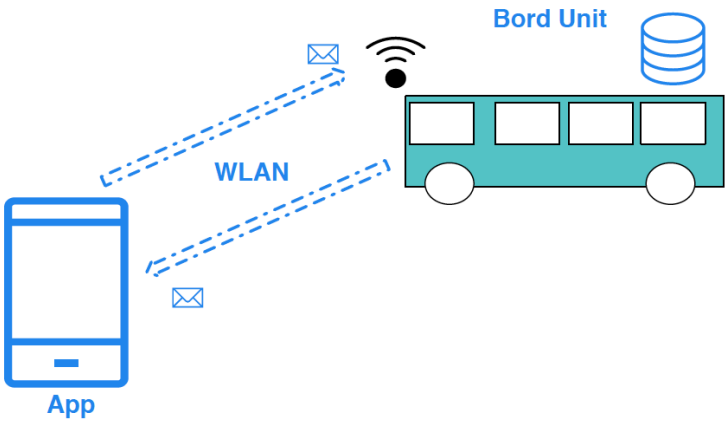
- Idea
  - Person send signal via app to the bus
  - Vehicle responses
  - Bus driver gets the additional Infos



First Approach – Communication with WLAN

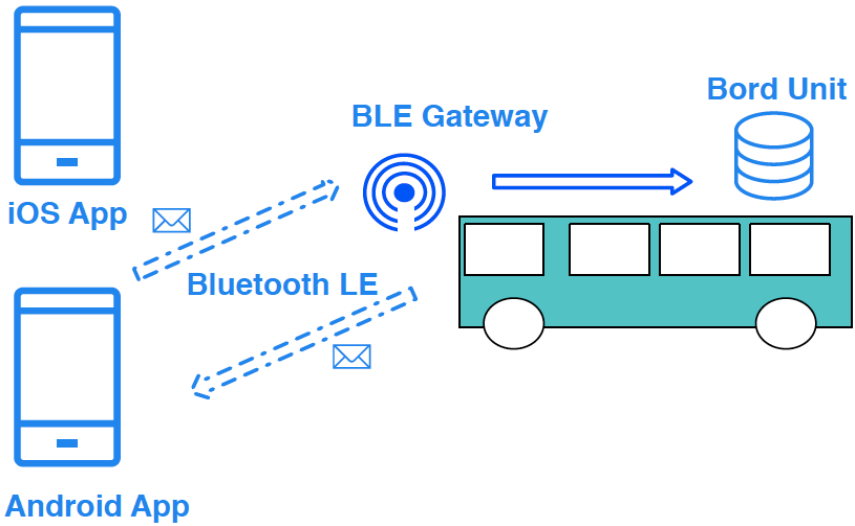
- Problem 1: time critical
  - Establishing a stable connections takes 10s to 1min

- Problem 2: WLAN integration not possible in iOS
  - No WLAN Integration in iOS App
  - no API



Second Approach – Communication with BLE

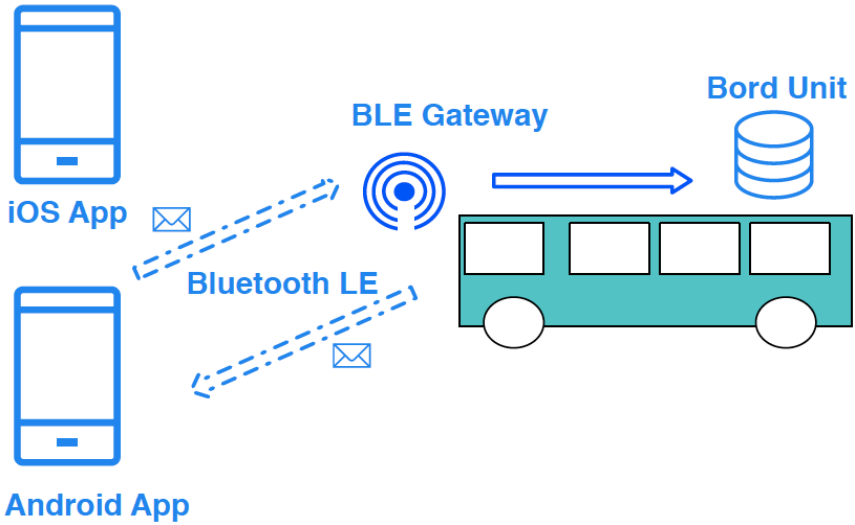
- BLE – Blue Low Energy
  - Broadcast possible
  - no handshake
  - Fast connection
  - iOS and Android



  - Limited range: 90 m
    - Ok in cities, but not on the countryside

Second Approach – Communication with BLE

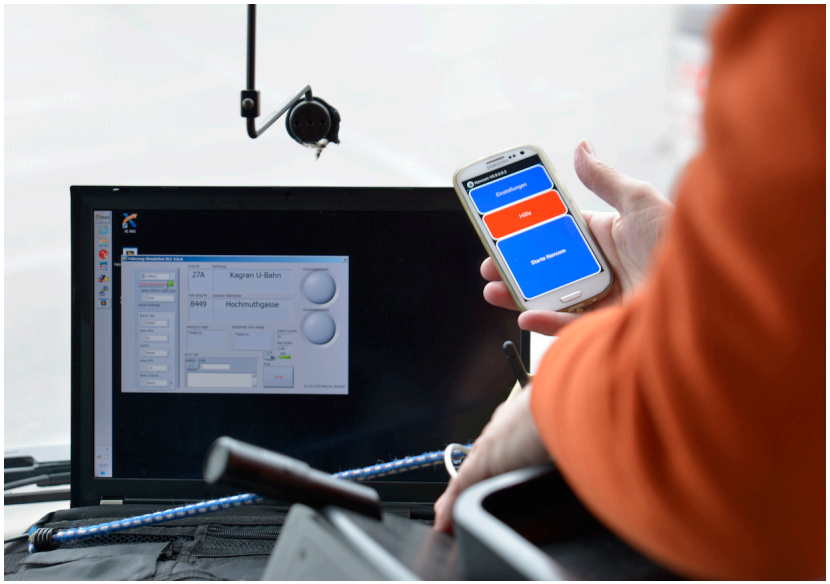
- Bus to App
  - Possible to send any of the Bus information System
    - e.g. Line number, next station, etc.



- App to Bus
  - Send entry request or door opening signal
  - Send information about the user (e.g. wheelchair driver)
  - Direct information to the Bus driver

App Interaction

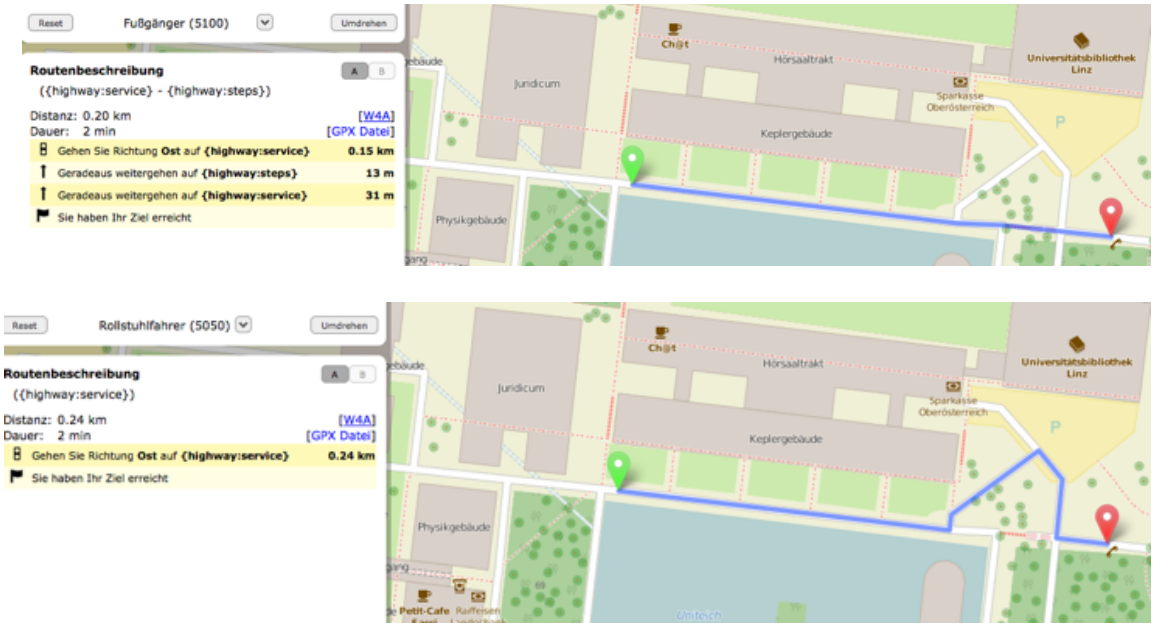
- Simplified User Interface
  - User Profile
  - Straightforward Workflows
  - Supporting system Text to Speech



- Manual vs. automatic interaction
  - Manual: requesting the bus audio signal or sending an entry request
  - Automatic: communication with the vehicle based on predefined trip and actual position

Guiding Users to the Bus Stop

- Routing Server
  - Based OSRM (Open Source Routing Machine)
  - Special Configuration for different User profiles
    - Pedestrian
    - Wheel chair



Evaluation 1 – Proof of Concept

- Integration in public transport vehicle
- 4 test users
  - Visually impaired and Blind
  - Age 48 to 60

- Proof of Concept OK
  - Finding the right bus
  - Get the bus Information
  - Sending an entry request

Evaluation 2 - Stress test

- 4 Bus lines
- 2 driving directions
- 16 Test users

https://commons.wikimedia.org/wiki/File:October_4th_Tube_Strike_--_Crowded_

- Deadlocks
  - To many requests
  - Real life situation differs too much from lab setup

- Improvements
  - Separate system broadcast and user request

Conclusion

- Bluetooth LE is possible for bi-directional vehicle communication
- Direct connection to the bus system is possible
- Apps for iOS and Android

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Thank You!

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