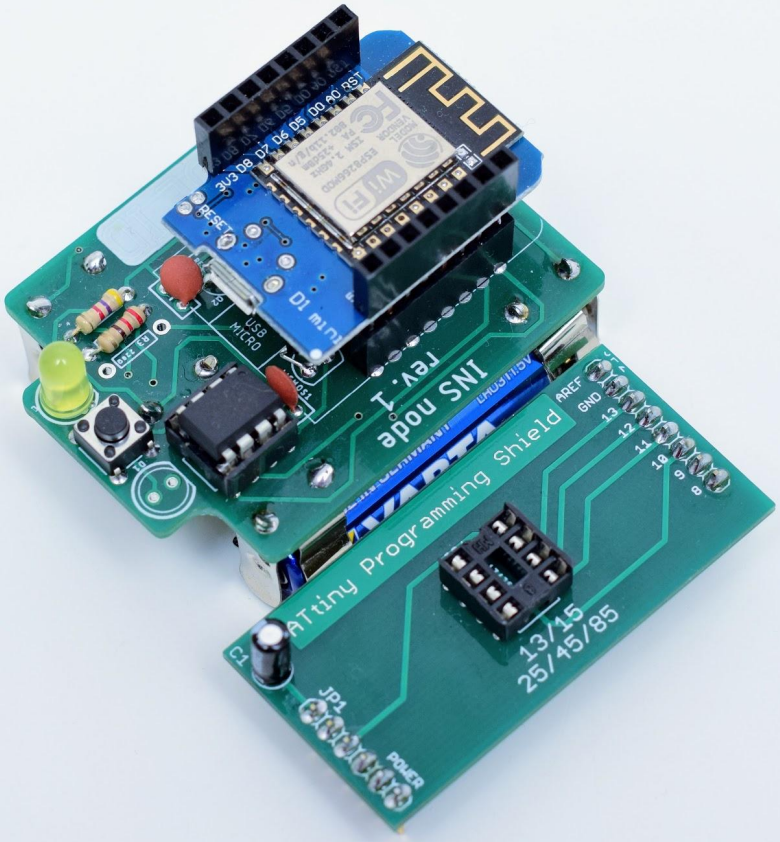
Indoor Navigation System

Kickoff Event

https://github.com/platisd/indoor-navigation-system



Agenda

- Introduction to INS
- Current status
- Vision
- How to get on board
- Demo
- Questions & Feedback

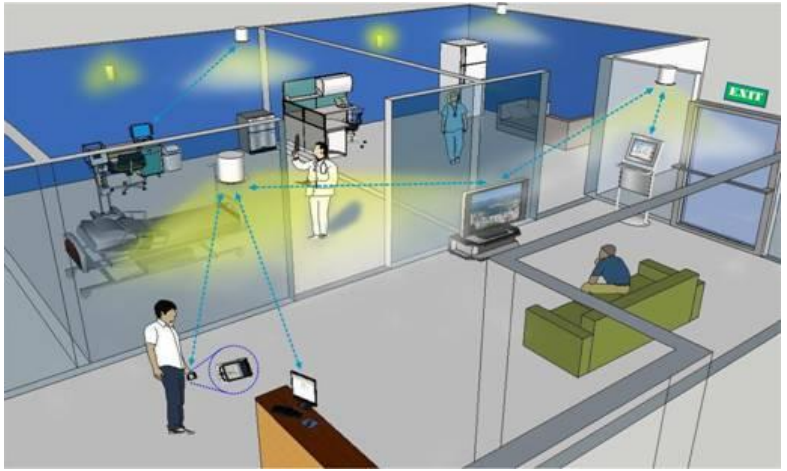
How we got here

- Initiative to form a hobbyist group.
- Enhance developer community in Aptiv.
- Network to share ideas, knowledge base & skills.
- Group Members :
    - Alex, Dimitris, Samuel.

Introduction to INS

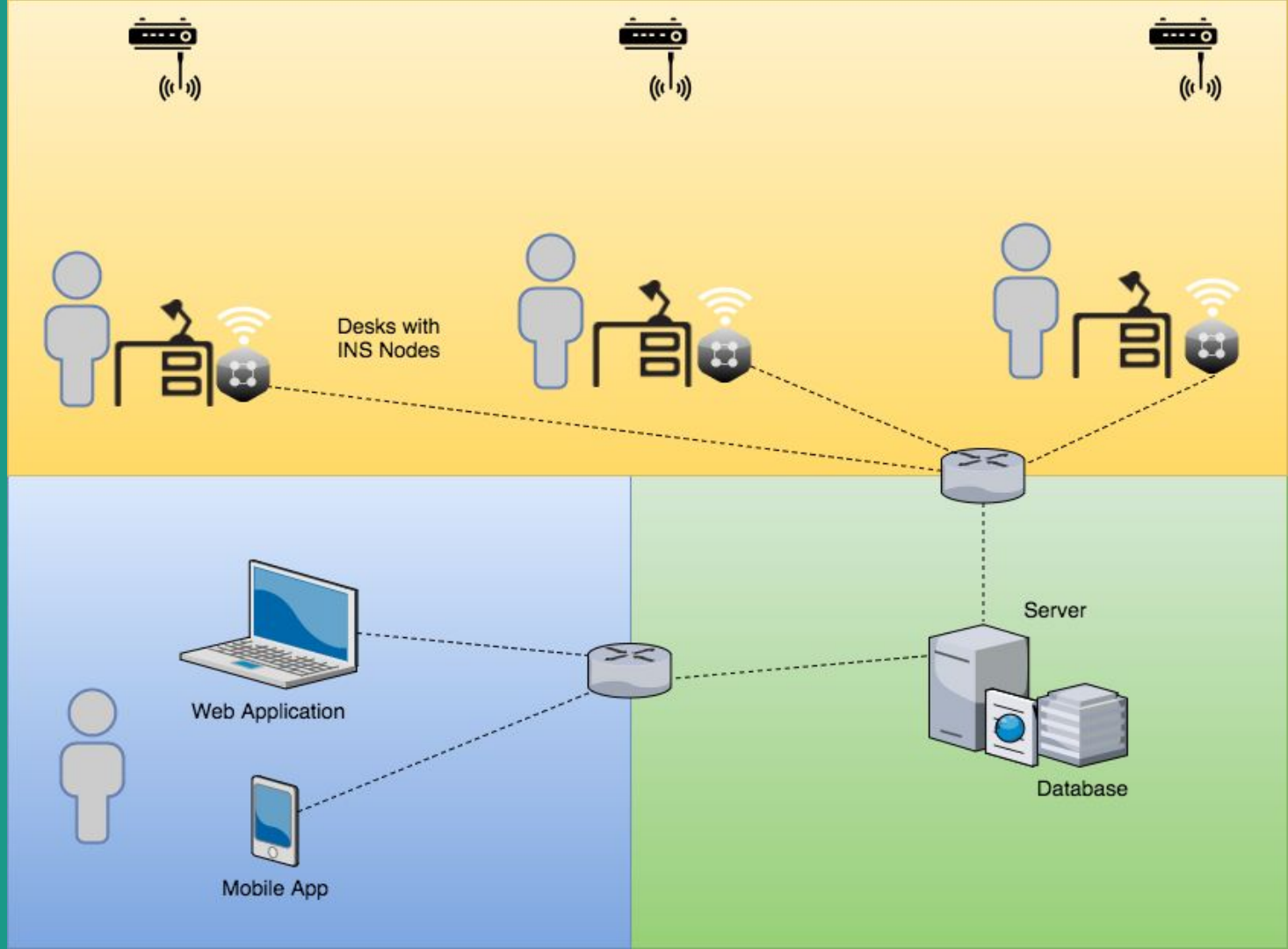
An indoor navigation system that guides you to the desk of your colleagues.

- Initiative to form a hobbyist group
- Locate colleagues' desks, resources easily
  - Coordinate point on map..
  - Navigation aid to point on map



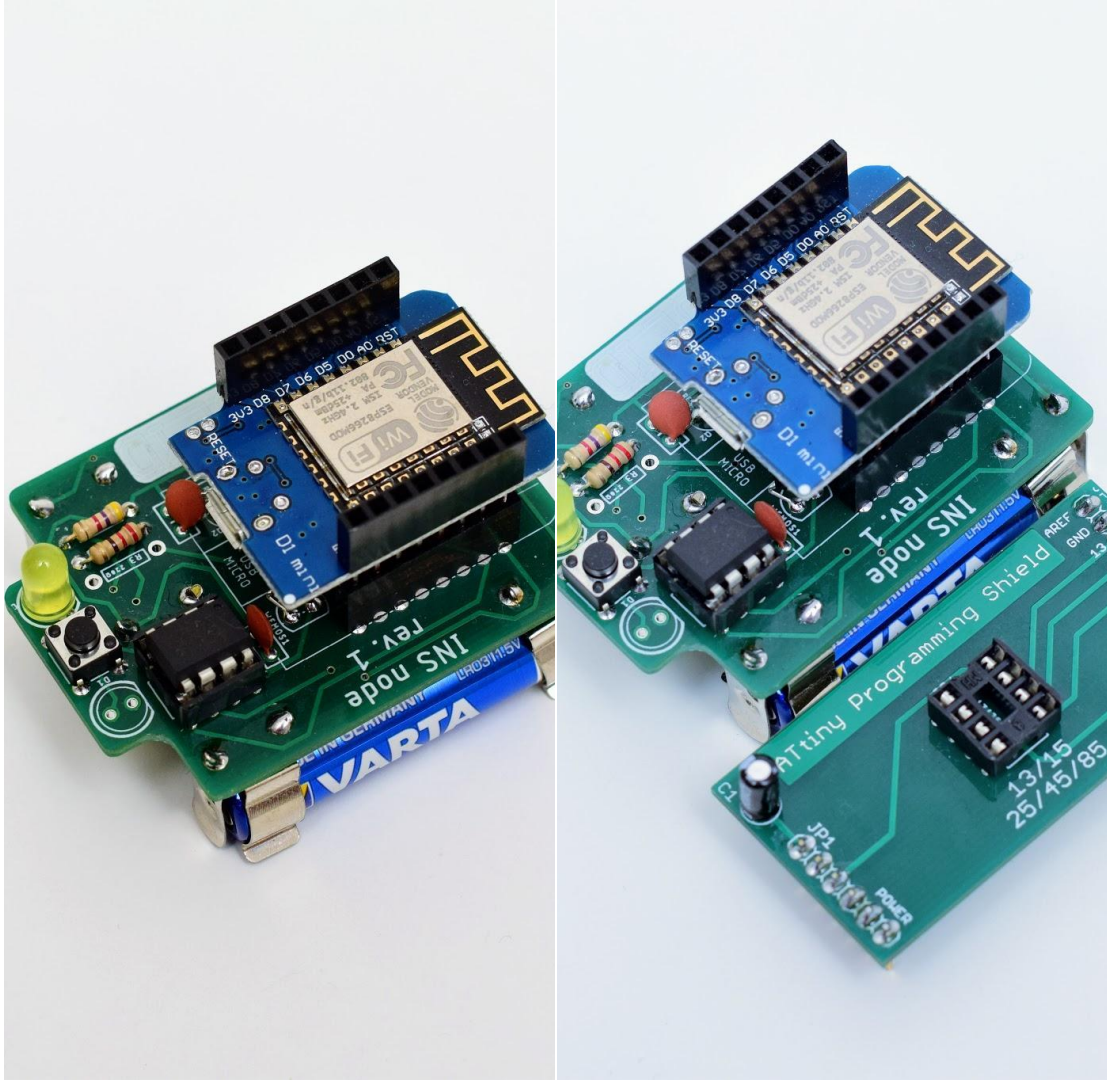
How it works

- Three layers
  - Nodes
  - Server
  - Client App



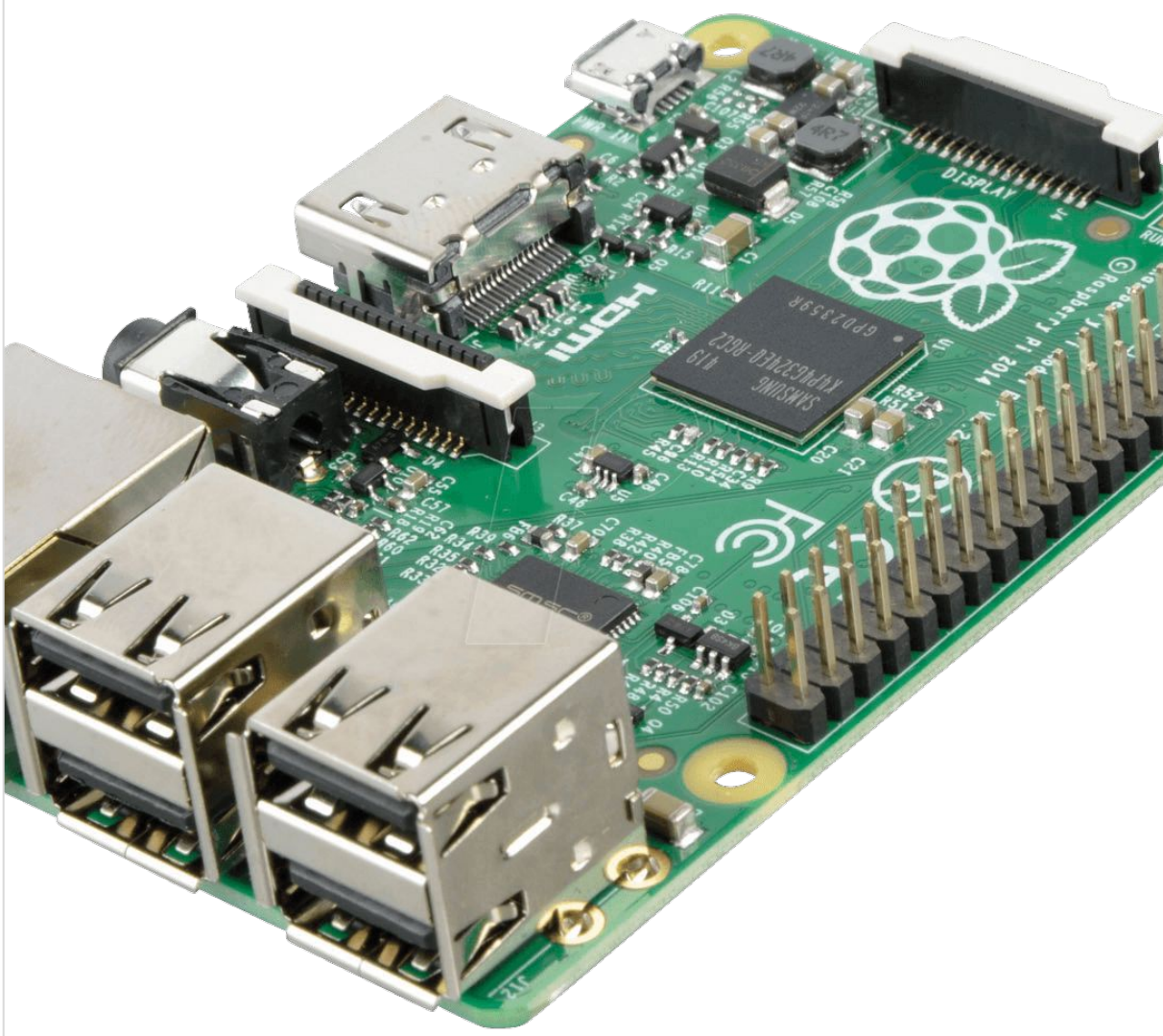
INS Node

- Portable device
- Transmits WiFi signal strength
- WiFi Module (ESP8266)
- Power Controller (ATtiny85)



Server

- REST server
- Persistent data storage
- WiFi RSSI localization
- Raspberry Pi (or NUC)



Client

- Queries INS for location
- Visualizes nodes location
- Provides navigational instructions
- Android (Currently), Web (TBI)

Current Status

.gitattributes	Add INS-node board prototype	3 months ago
.gitignore	Add coverage reports for ins-app	21 days ago
.travis.yml	Use android target version as a variable	16 days ago
CODE_OF_CONDUCT.md	Add code of conduct document	2 months ago
CONTRIBUTING.md	Add contribution guidelines	2 months ago
ISSUE_TEMPLATE.md	Add issue template	2 months ago
LICENSE	Initial commit	3 months ago
PULL_REQUEST_TEMPLATE.md	Fix wording	2 months ago
README.md	Fix wording	6 days ago
get_dependencies.sh	Make script executable	2 months ago
run_coverage.sh	Add coverage reports for unit tests	16 days ago

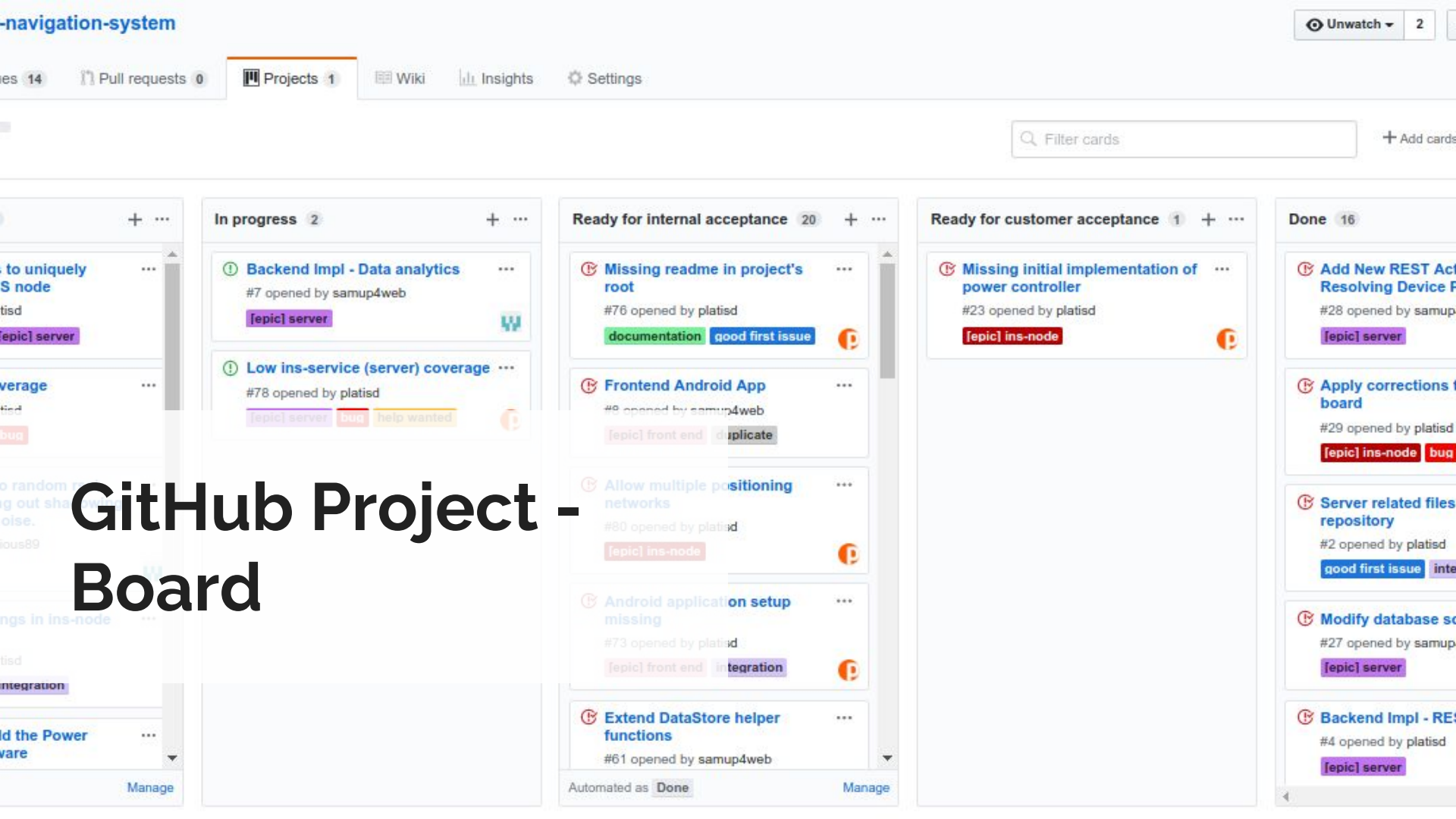
Github Project - Repository

README.md

Indoor Navigation System

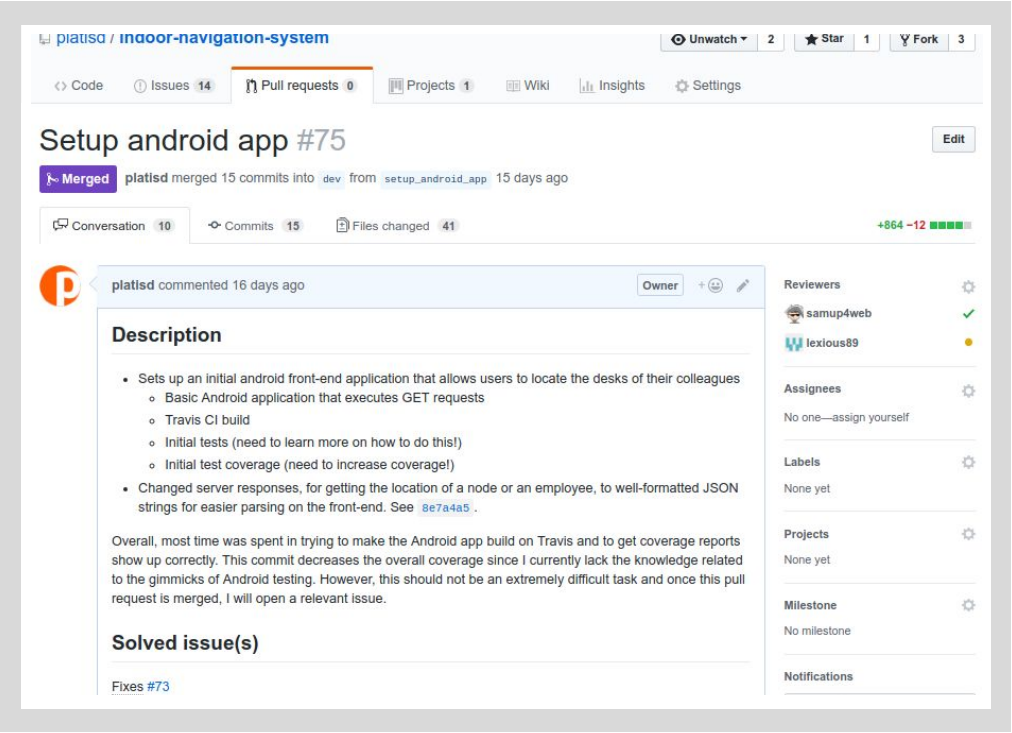
build passing codecov 71%

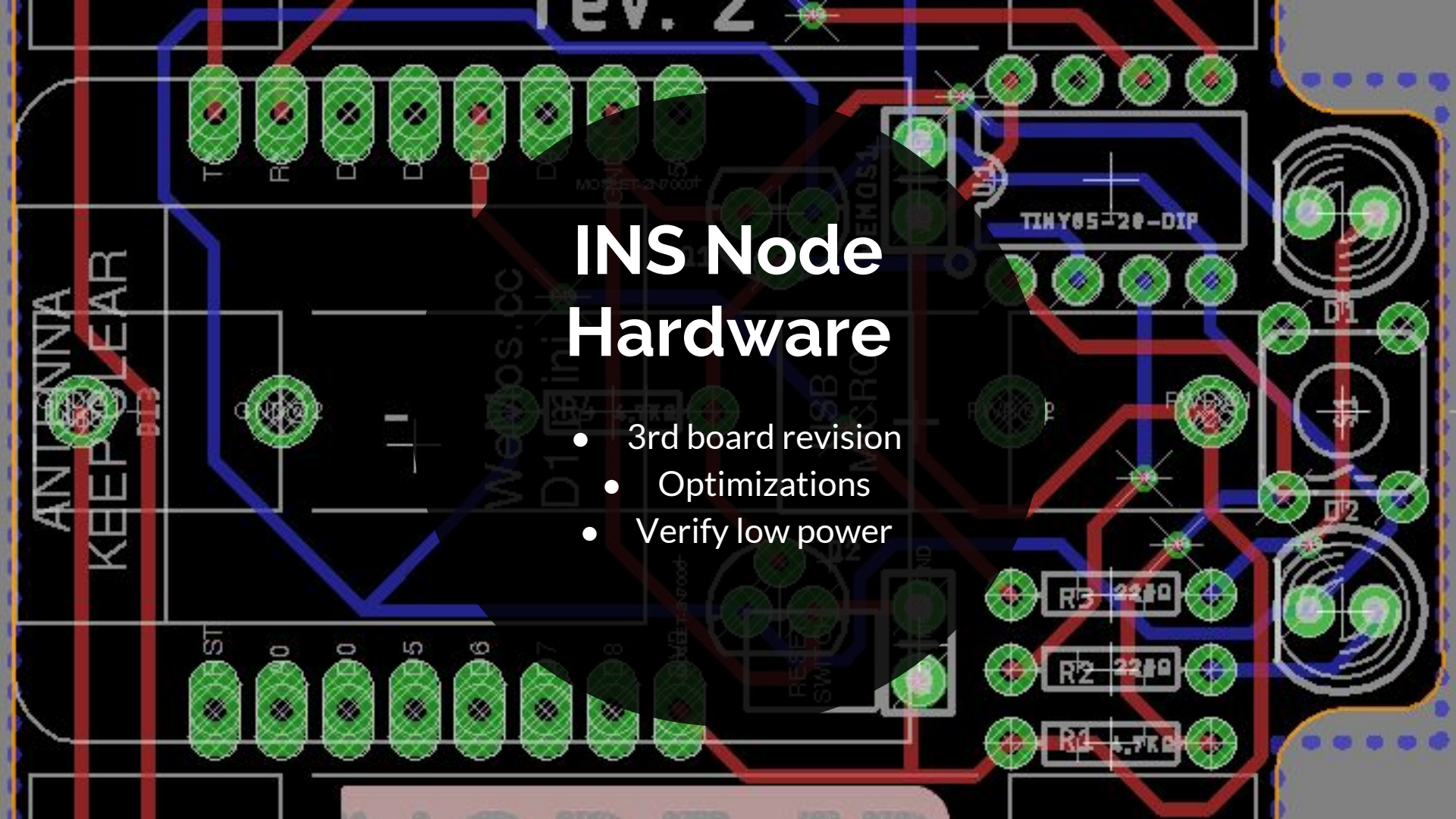
[WIP] An indoor navigation system that guides you to the desk of your colleagues.



GitHub Project - Board

GitHub Project - Pull Requests





INS Node Hardware

- 3rd board revision
- Optimizations
- Verify low power

HTTP REST Server

- Pistache - http://pistache.io/

INS NODE

```
POST  http://localhost:9080/set_rssi/15/23:43:3d:3e:5e:f5/12.323/5a:4e:44:ff:5a:6e/44.3434
```

```
POST   http://localhost:9080/resolve_pos/15
```

```
POST   http://localhost:5300/reset_pos/15
```

APP

```
GET   http://localhost:5300/get_device_pos/15
```

```
GET   http://localhost:5300/get_employee_pos/3405
```

Backend Database

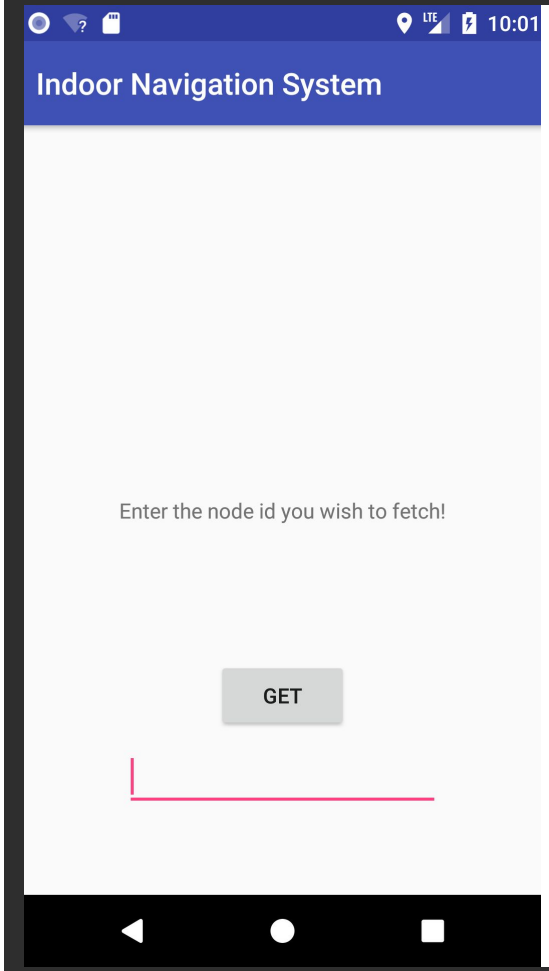
SQLITE

```
-- Stores wifi access points information --
CREATE TABLE access_points
(
  mac_addr TEXT PRIMARY KEY,
  pos_x REAL,
  pos_y REAL,
  pos_z REAL
);
```

```
-- Stores mac_addr/rssi info from device id - dev_10 --
CREATE TABLE sample_dev_10
(
  id INTEGER PRIMARY KEY,
  mac_addr TEXT,
  rssi REAL,
  timestamp datatime default current_timestamp
);
```

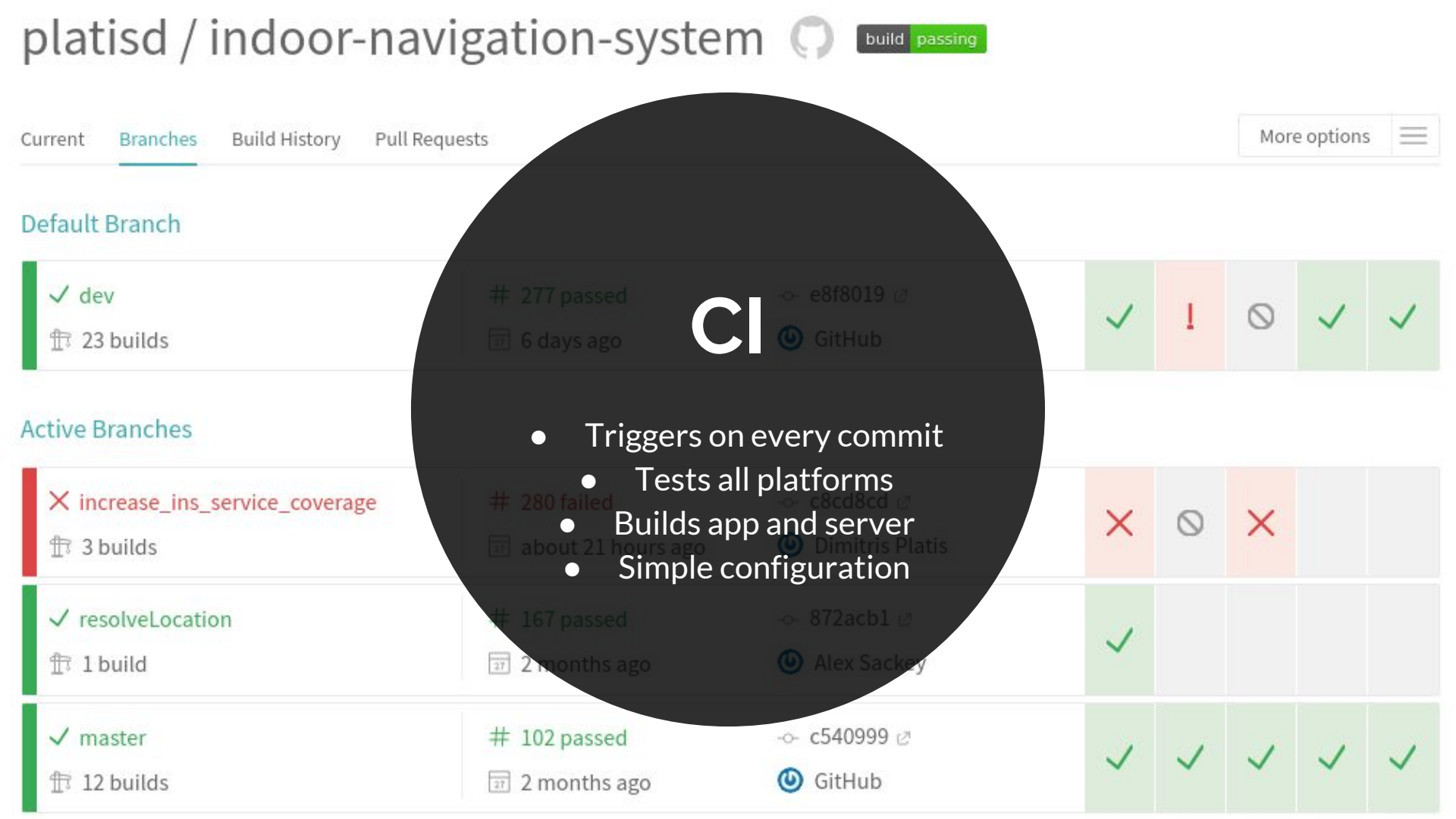
Localization

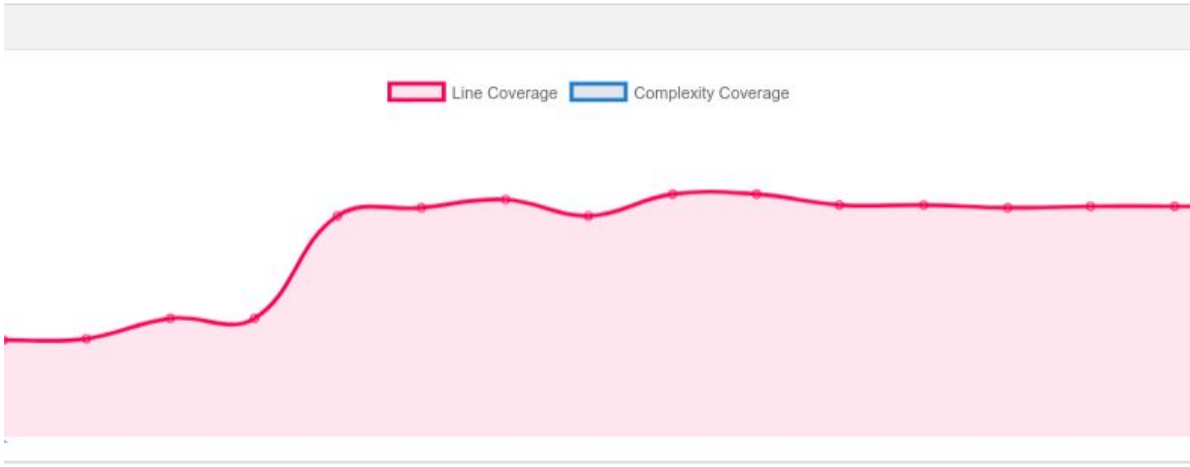
```
-- Stores location records --
CREATE TABLE location
(
  device_id INTEGER PRIMARY KEY,
  employee_id TEXT,
  pos_x REAL,
  pos_y REAL,
  pos_z REAL,
  timestamp datatime default current_timestamp
);
```



Android App

- Basic app to find node location
- Node ID as parameter
- Location data


platisd / indoor-navigation-system
build passing
Current
Branches
Build History
Pull Requests
More options
Default Branch
dev
23 builds
277 passed
6 days ago
e8f8019
GitHub
Active Branches
increase_ins_service_coverage
3 builds
280 failed
about 21 hours ago
c8cd8cd
Dimitris Platis
resolveLocation
1 build
167 passed
2 months ago
872acb1
Alex Sackey
master
12 builds
102 passed
2 months ago
c540999
GitHub
CI
Triggers on every commit
Tests all platforms
Builds app and server
Simple configuration



Test Coverage

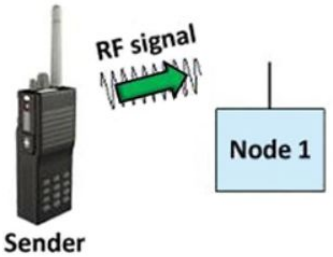
- Fancy graphs
- Easy to access
- Triggered by CI

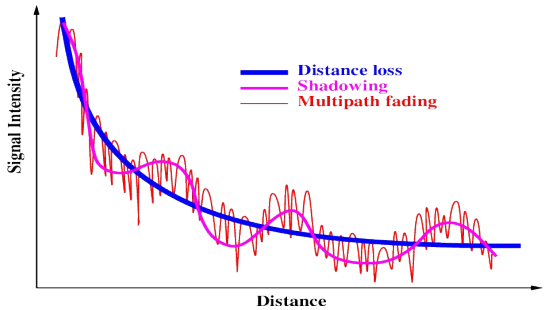
Position localization - Trilateration

- RSSI levels from wifi points to be used
- RSSI is mapped to received power level
- Multiple power levels measured over fixed sample times
- Random shadowing and fast fading is removed by filtering (Kalman) over time
- Distance computed with pathloss power received

$$\frac{P_r}{P_t}(dB) = 10\log_{10} K - 10\gamma \log_{10}\left(\frac{d}{d_0}\right) + \psi_{dB},$$

$$\psi_{dB} \sim N(0, \sigma_\psi^2)$$

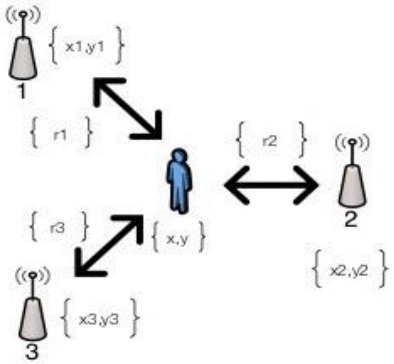




Position localization

- Known positions for all wifis in building
- With known positions of wifis as center of the circle, distance from received power, solve the three circle problem = {x,y,z}

$$(x_s - x_1)^2 + (y_s - y_1)^2 = (r_s - s_1 r_1)^2$$
$$(x_s - x_2)^2 + (y_s - y_2)^2 = (r_s - s_2 r_2)^2$$
$$(x_s - x_3)^2 + (y_s - y_3)^2 = (r_s - s_3 r_3)^2.$$



Position localization

Wifi A :
Mac address: a0:3d:6f:1e:4a:1c ->
Position: 2.1,5.2,3
distance -> Power level to ins node:

↓

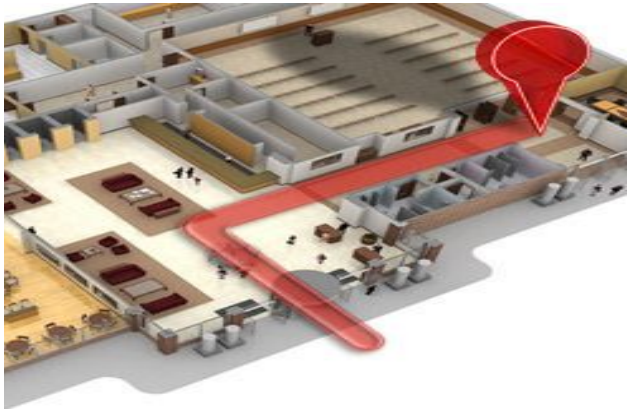
INS node position {x,y,z}

↓

Sent to android App and scaled and mapped to facility map.

Vision

- First phase
  - Location detection with no navigation
- Second phase
  - Active navigation assist
  - Google Assistant or Alexa integration
  - Enhanced security
  - OTA updates / Continuous Deployment
  - Cool casing for nodes



How to get on board

- Create github account (or use existing account)
- Open issue on repository
- Request collaborator access
- Request Slack channel access
    - Provide your Aptiv username (e.g. johan.johansson)
- Github repo - platisd/indoor-navigation-system

Time for action!

Questions?

github.com/platisd/indoor-navigation-system