# Detection of incorrect beacon placement

The software is intended for detection of proximity beacons which were installed into incorrect location, were moved during the exploitation or have inconsistent information in proximity database. A result is a list of proximity beacons which must be ignored during proximity-based positioning.

## Server interaction

The procedure should be deployed on AWS server. The interaction of procedure of incorrect beacon placement detection with other components is shown in a figure below.

## 

The procedure of incorrect beacon placement detection is executed from time to time after collecting a large portion of Coursa Venue datasets.

## Architecture

Theprocedure utilizes datasets collected with Coursa Venue and generates list proximity beacons to ignore in proximity positioning.



The input is a set of “\*ipl\_raw.bin” and “\*cal\_data.bin” files coming from Coursa Venue app installed on customer smartphones. These data are transferred to server and processed with IRPL processor. Then Bluetooth fingerprint \*.bfp3/\*.bfp4 is built by using generated “nav.dat” files and venue.json file. After that proximity\_ignore\_list.json fle is generated with Detection of Beacons Placement Errors (DBPE) tool and finally proximity\_ignore\_list.json file is merged with ignore\_list.json

## List of Components to be deployed:

|  |  |  |
| --- | --- | --- |
| Name | Link / Location | Comment |
| IRPL processor | For initial version:  GitHub/Coursa-Venue-Realtime/ | HealWFP\_fromMFP branch  After and of debugging the location and branch will be changed. |
| FP builder console | Github/Gift/Applications/fp\_builder.console/FP\_builder/ | master\_incorrect\_beacon\_detection branch |
| DBPE tool | Github/Gift/Tools/incorrect\_beacon\_detection/ | master\_incorrect\_beacon\_detection branch |
| Merge ignore list python script |  | Will be realized after finishing of experimental exploitation |

## Component requirements and usage

* 1. Required OS: Linux

Ubuntu 14.04 is preferable OS version. It should be configured as the OS on cayyc-lc001 server.

The Coursa-Venue-Realtime repository IRPL processing script must be checked first. The IRPL processing results should be the same as with cayyc-lc001 server. This is mentioned because cayyc-lc003 has different (incorrect) results of IRPL processing for the same data.

* 1. IRPL processing

Before using IRPL processing, the build script must be ran once using the following commands:

cd <...>/Coursa-Venue-Realtime/zeus/linux/LinuxOffline/

python ./scripts/build.py irpl

* 1. FP builder

FP builder must be taken from *master\_incorrect\_beacon\_detection* branch of Gift repository and executable file (fpbuilder.out) must be created by building the FP builder library and FP builder application. FP builder must be run with command line key --xblp\_detection on.

Example: fpbuilder.out --settings venue.json --ignore\_list ignore\_list.json --xblp\_detection on

* 1. DPBE tool

Python version 3.7 or higher is required with the following additional packages installed:

json, random, numpy, loging, re, math, os, sys

The current version of the tool works with ble3 and blp3 databases. In future, the tool will be updated to use ble4 and blp4 databases.

## Detection of Proximity Beacons Placement Errors python tool

A Python tool for Detection of Beacons Placement Errors (DBPE) serves for detecting of placement errors of BLE proximity beacons regarding positions in the beacons database for the venue.

Command line arguments:

"-sm", "--settings\_main" – main settings json file with venue settings,

"-se", "--settings\_extra" – extra settings json file with extra settings dpbe\_settings.json,

"-blp", "--blp3\_fp" – proximity beacons data base file,

"-ble", "--ble3\_fp" – ble fingerprint file.

"-blpi", "--blp\_ignored", description is "proximity beacons ignored list".

Example of command line:

python main.py -sm venue.json -se dpbe\_settings.json -blp venue.blp3 -ble venues.ble3 -blpi blp\_ignore\_list.json

Notes:

settings\_extra can be absent, in this case extra settings will be applied from main settings json file or by default if they are not presented.

main settings json file must include the following settings and parameters:

"name", "venue"

Example of main settings json:

{

"name": "venue name",

"venue" :

{

"origin\_lattitude" : 38.632861000000005,

"origin\_longitude" : -90.315916693984036,

"origin\_azimuth" : -96.723687782577386,

"alfa" : 0.0,

"beta" : 0.0,

"size\_x" : 140,

"size\_y" : 85

}

}

Extra settings for DBPE tool can be provided in extra settings json file or in main settings json file as fields of structure “incorrect\_beacon\_detection”. See details in table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Setting | Default value | Dimension | Description |
| max\_position\_intolerance | 5 | m | Maximal allowed difference of estimated beacon position and original beacon position in proximity database. The beacon is added to ignore list if the difference is more than this value. |
| min\_cells\_number | 1 | n/a | Minimal number of cells for beacon position assessment |
| max\_cells\_number | 10 | n/a | Maximal number of cells for beacon position assessment |
| max\_iterations\_number | 20 | n/a | assessment iterations number limit |
| RSSI\_cutoff\_threshold | -13 | dBm | RSSI cutoff threshold relative to beacon Tx power for using proximity BFP data in assessment |
| min\_bfp\_cell\_weight | 0.25 | n/a | Minimal weight of non-empty mode of proximity BFP cell for using proximity BFP data in assessment |

Example of the extra settings:

"incorrect\_beacon\_detection":

{

"max\_position\_intolerance": 5

"min\_cells\_number": 4,

"max\_cells\_number": 10,

"max\_iterations\_number": 20,

"RSSI\_cutoff\_threshold": -13,

" min\_bfp\_cell\_weight": 0.25,

}

Beacons ignored list for beacons with placement error more than max\_distance threshold is a result of DBPE procedure.

Beacons ignored list is json file and has format as

{

"blp\_ignore\_list":

[

{

"uuid": "f7826da6-4fa2-4e98-8024-bc5b71e0893e",

"major": 2543,

"minor": 921,

"hash": 166658969

},

{

"uuid": "f7826da6-4fa2-4e98-8024-bc5b71e0893e",

"major": 4314,

"minor": 27488,

"hash": 282749792

},

{

"uuid": "f7826da6-4fa2-4e98-8024-bc5b71e0893e",

"major": 5050,

"minor": 64136,

"hash": 331020936

}

]

}

Beacons ignored list should be used as input parameter for FP Builder to rebuild proximity beacons data base.

The following debug information is logged in std output stream:

major, minor, ble\_prox\_hash, x\_calc, y\_calc, x\_expected, y\_expected, distance, iter\_number, number of cells

2543, 921, 166658969, 79.91233878, 63.40702551, 94.31228592, 63.4747034, 14.40010617, 12, 68

4314, 27488, 282749792, 73.96690273, 29.83009092, 82.08730716, 25.02908674, 9.43348341, 15, 30