Review Open Call SME Experiments

SDR4IoT

ALEXIS DUQUE

Rtone

REVIEW OPEN CALL F4FP-SME-1

Remotely - Thursday, 2nd April

RTONE
IOT Makers

Rtone

Experiment Description

Experiment Description

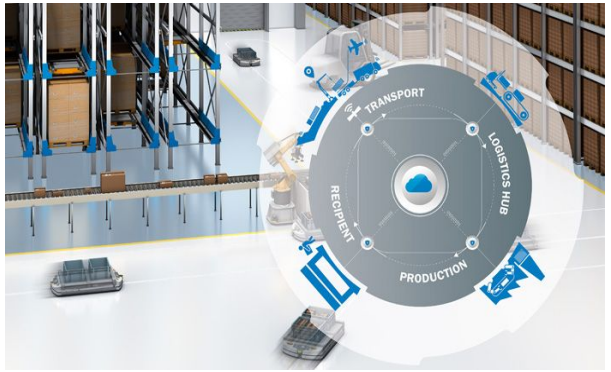
Concepts and Objectives

- ***IoT** Device **Fingerprinting** and **Localization** Using **Software Defined Radio***
- Use off the shelf emitter from true IoT nodes
- Widely used RF protocols in 2.4 GHz ISM band
- **SDR-based** receiver
- Collect and share a large dataset and reproducible RF fingerprints
- Further rely on Machine Learning for authentication and localization

Experiment Description

Background and Motivations

- **SDR** hardware is popularizing
- Software library are maturing (e.g. **GNU Radio**)
- Lot of interest and work in academia. New for industry
- **Indoor IoT devices** need **passive auth** & **localization**



Experiment Description

Experiment Setup

1. Make a **reservation** on the testbed Web UI
2. Setup the experiment **scenario** and **provision nodes** using **our automation scripts**
3. Use mobile nodes equipped with a Huawei **Nexus 6P** to run a **custom Bluetooth Low Energy App** that advertises as an HRM Peripheral

Experiment Description

Experiment Setup

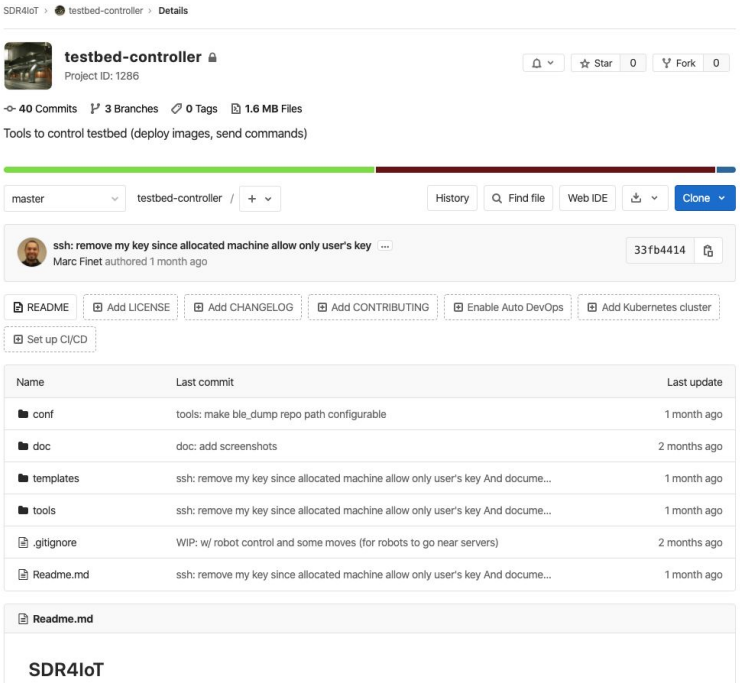
4. **Move** the mobile node **robot** to a fixed position
5. Use the **USRP N210 node(s)** to **receive** and demodulate the **BLE Advertising** packet using GNU Radio
6. Save **raw IQ** and advertising packet as **PCAP**
7. **Exploit** the dataset on **JupyterLab**

Project Results

Project Results

Automation Script

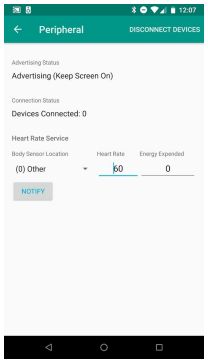
- Tools written in Python and Bash
- Generate ESpec
- Easily **choose nodes**, create a scenario, provision server node, mobile nodes, **USRP(s)** and **smartphone(s)** on w-iLab.2 testbed



Project Results

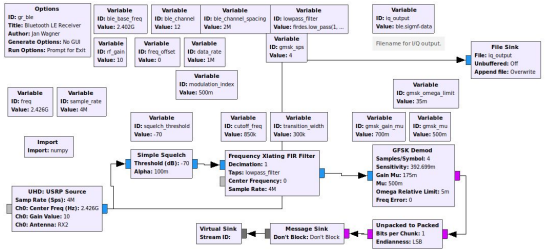
Emitter

- Mobile App to advertise BLE packet
- CSV and script to **move** and **track robot position**



Receiver

- GNURadio Companion application
- 2 export formats
  - **PHY** layer: raw IQ
  - **APP** layer: BLE packet
  - WIP: **sigMF**



Project Results

Dataset

- 100+ Go of data collected
- 3 scenarios (more in Phase 2)

Apply a display filter ... <Ctrl-/>

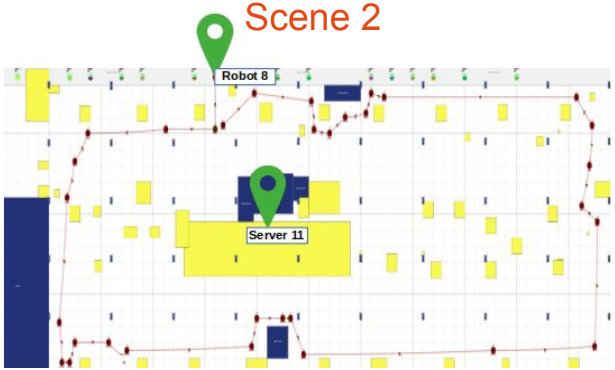
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
2	1.074137	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
3	2.143532	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
4	3.854244	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
5	9.421540	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
6	13.246563	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
7	16.233006	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
8	17.947419	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND
9	18.807432	69:89:d0:3c:da:e7	Broadcast	LE LL	35	ADV_IND

```
Frame 2: 35 bytes on wire (280 bits), 35 bytes captured (280 bits)
Bluetooth
Bluetooth Low Energy RF Info
Bluetooth Low Energy Link Layer
  Access Address: 0x8e89bed6
  Packet Header: 0x1040 (PDU Type: ADV_IND, ChSel: #1, TxAdd: Random)
  Advertising Address: 69:89:d0:3c:da:e7 (69:89:d0:3c:da:e7)
  Advertising Data
  CRC: 0xe288ab
```

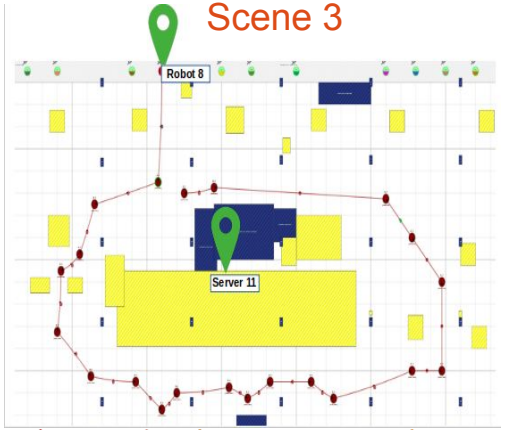
```
0000  00 ff ff 00 d6 be 89 8e  37 3c d6 be 89 8e 40 10   ........ 7<....@.
0010  e7 da 3c d0 89 69 02 01  1a 02 0a 01 03 03 0d 18   ..<..i.. ........
0020  47 11 d5                                          G..
```

Scene 1

Scene 2

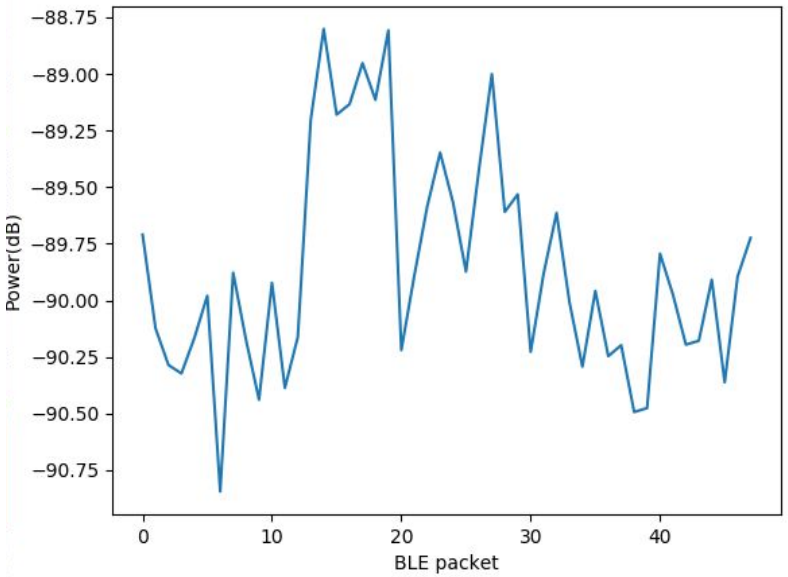


Scene 3

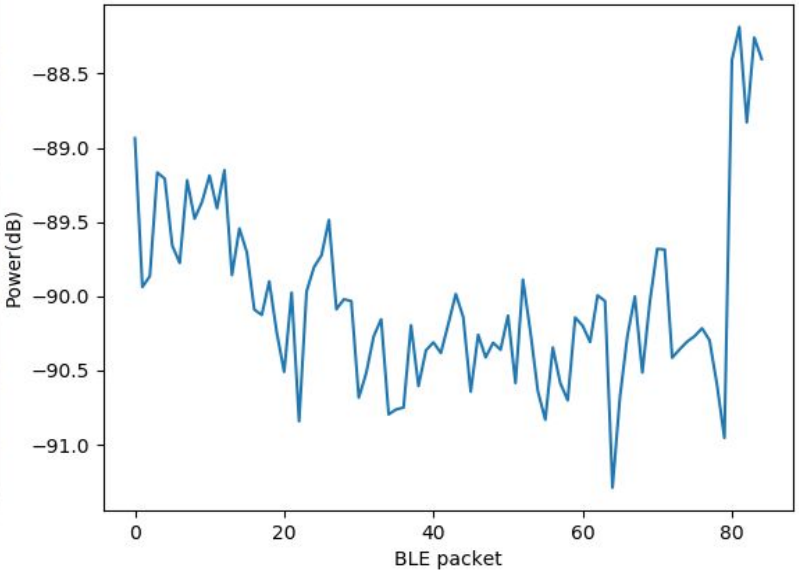


Project Results

Scene 2



Scene 3



Business Impact

Business Impact

Team training and learning

- **acquire knowledges and new competences**
  - Software Defined Radio
  - RF
  - Ansible
  - FED4Fire tools
- work on **research project** close to academia

Communication

- **blog** post about SDR 🇫🇷
- **talk** at FOSDEM
- social networks

Business Impact

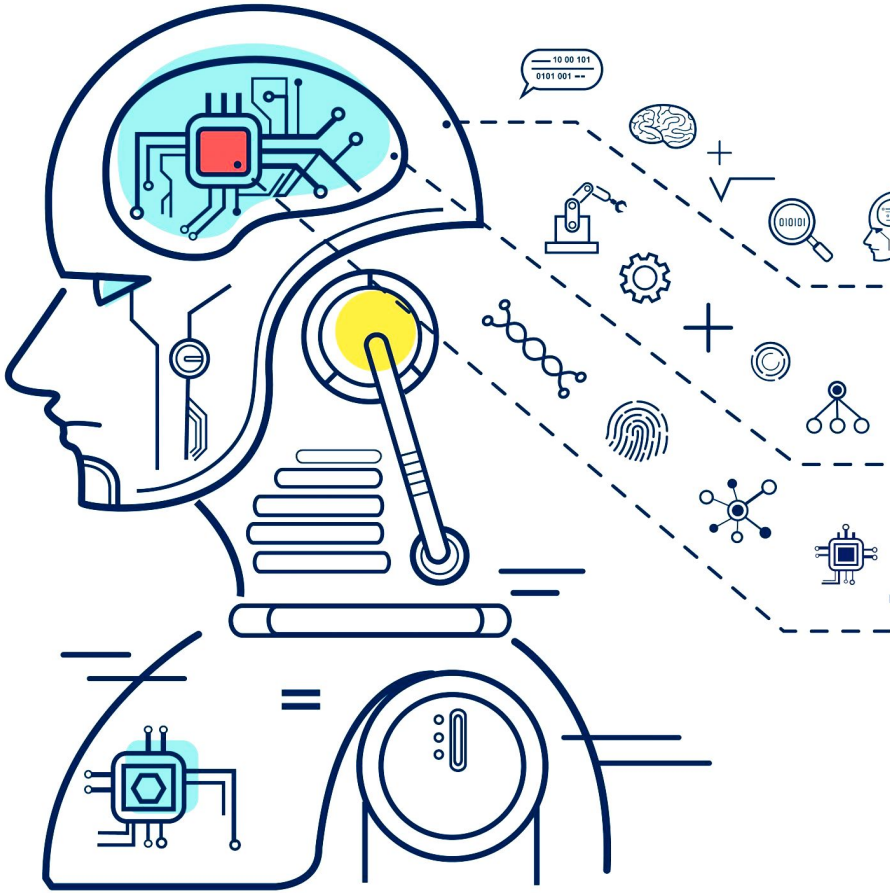
New Business and R&D Opportunity

- **new IP** for our company to provide a secure way to localize and authenticate IoT devices
- **authentication** of **autonomous vehicles** or robots in a **building** according to their localization
- **driven by industry recent needs**
- working for few months in the development of a **Software Defined Radio based IoT gateway** for a **French industry leader.**

Business Impact

Value Perceived

- **Support** in terms of **federation** of testbeds available through single account
- **Grant** for successful experiments
- **Technical support**
- Many **infrastructure** and **nodes**
- Proof of **our interests** for the testbeds
- **Scalability**
- Confidence to r**un experiments on Fed4FIRE+ in future**

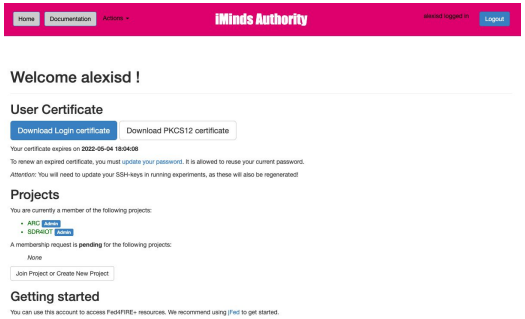


Feedback

Feedback

Used Ressources and tools

- **Fed4FIRE+ Tools**
  - iMinds Authority
  - jFed CLI and jFed GUI
- **w-iLab.2**
  - Mobiles nodes with robots
  - USRP N210 server nodes
  - Huawei Nexus 6P
  - reservation Web UI
  - ***RobotController*** software
- **VirtualWall** (to be continued in Phase 2)
  - JupyterLab
  - GPU nodes



Feedback

jFed CLI

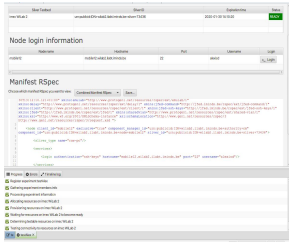
- Provision and manage experiment on testbeds
- Network and resource configuration
- Bootstrap an experiment

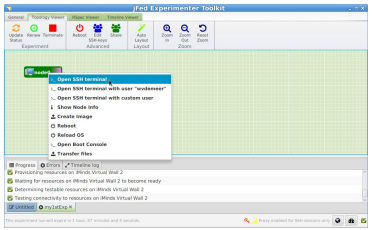
- Node provisioning takes a lot of time. Sometime fails
- Requested feature: place a reservation and book nodes with jFed CLI

Feedback

jFed GUI

- Provision and manage experiment on testbeds
- Load RSpec
- Bootstrap an experiment
- Recover an experiment





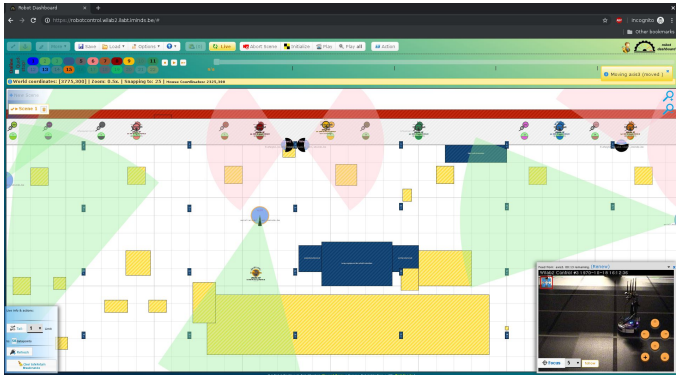
- Mainly used at the beginning of the experiment to get familiar with the testbed

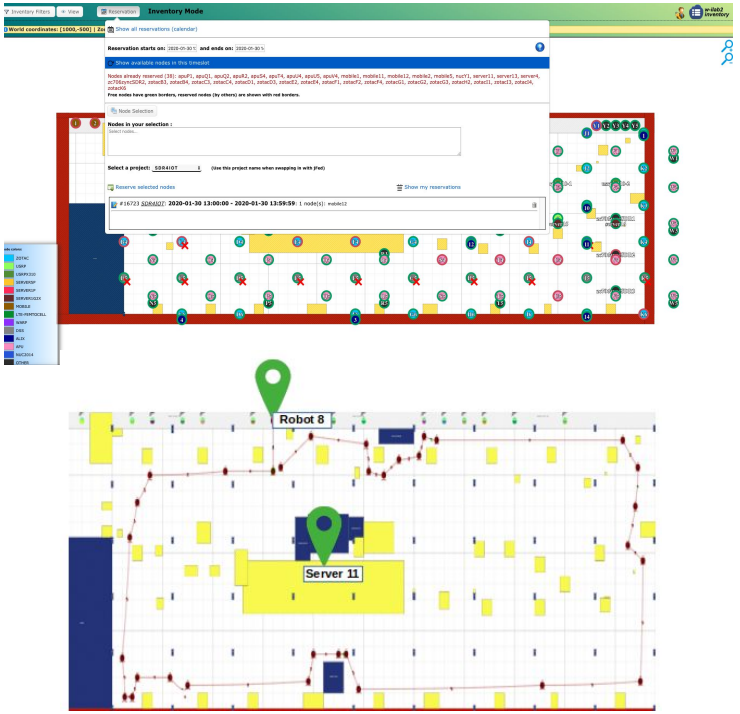
- UX could be improved.
- Quite unstable

Feedback

w-iLab.2 tools

- Reservation Web UI
- *RobotControl* Web UI
- *RobotController* ruby script software

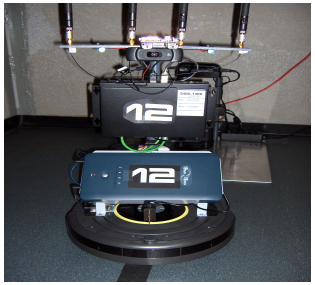




Feedback

w-iLab.2 nodes

- Mobiles nodes with robots
- USRP N210 server nodes
- Huawei Nexus 6P smartphones



GNURadio
THE FREE & OPEN SOFTWARE RADIO ECOSYSTEM

- mobile nodes availability
- smartphones and robots often have issues
- sometimes robot can't move

Feedback

Added Value for FED4Fire+

- **intensive use** and assessment of **mobile nodes**
- suggest **new features**
- suggest **new** type of nodes and **devices**
- **dissemination & communication**
- develop automation scripts that can be reused
- **share** datasets (on Zenodo after Phase 2)
- use **other testbeds in the future**

QUESTIONS

WWW.FED4FIRE.EU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Co-funded by the Swiss Confederation

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