



Review Open Call SME Experiments *SDR4IoT*



ALEXIS DUQUE

Rtone

REVIEW OPEN CALL F4FP-SME-1

Remotely - Thursday, 2nd April



RTONE
I O T M A K E R S



RTone



Experiment Description

Experiment Description

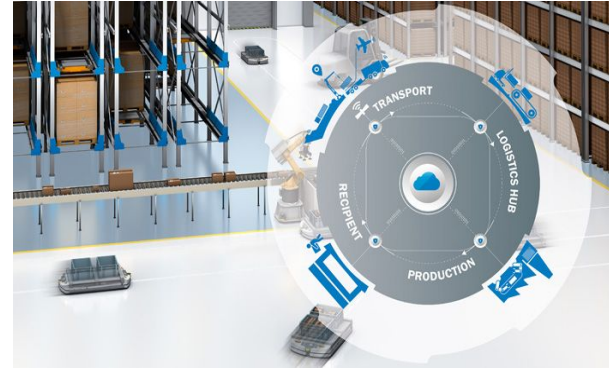
Concepts and Objectives

- ***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

SDR4IoT > testbed-controller > Details

testbed-controller
Project ID: 1266 🔔 0 ☆ Star 0 🍴 Fork 0

↔ 40 Commits | 3 Branches | 0 Tags | 1.6 MB Files
Tools to control testbed (deploy images, send commands)

master testbed-controller / + History 🔍 Find file Web IDE 📄 Clone

ssh: remove my key since allocated machine allow only user's key ... 33fb4414 🔗
Marc Finet authored 1 month ago

README Add LICENSE Add CHANGELOG Add CONTRIBUTING Enable Auto DevOps Add Kubernetes cluster
 Set up CI/CD

Name	Last commit	Last update
conf	tools: make ble_dump repo path configurable	1 month ago
doc	doc: add screenshots	2 months ago
templates	ssh: remove my key since allocated machine allow only user's key And docum...	1 month ago
tools	ssh: remove my key since allocated machine allow only user's key And docum...	1 month ago
.gitignore	WIP: w/ robot control and some moves (for robots to go near servers)	2 months ago
Readme.md	ssh: remove my key since allocated machine allow only user's key And docum...	1 month ago

Readme.md

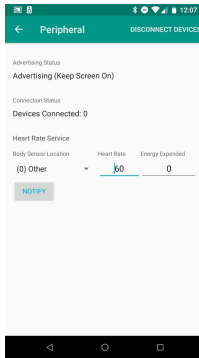
SDR4IoT

Project Results



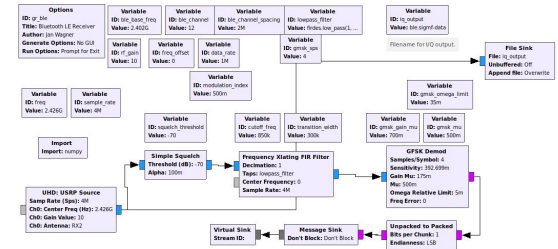
Emitter

- 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

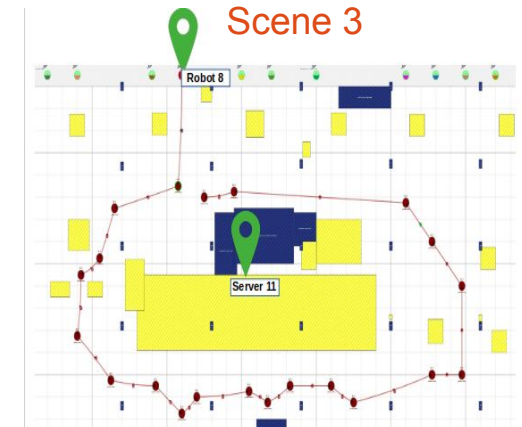
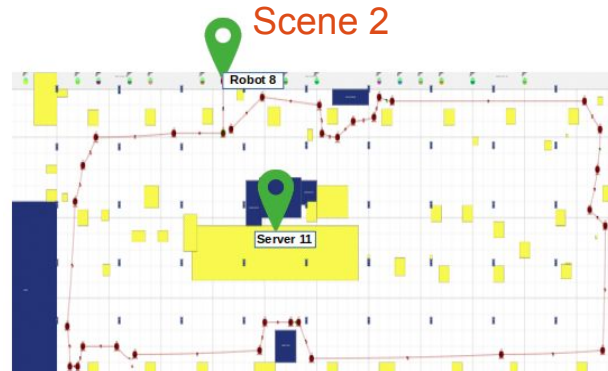
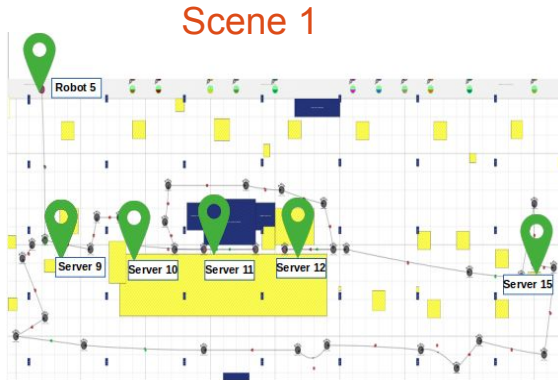
- 100+ Go of data collected
- 3 scenarios (more in Phase 2)

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
```

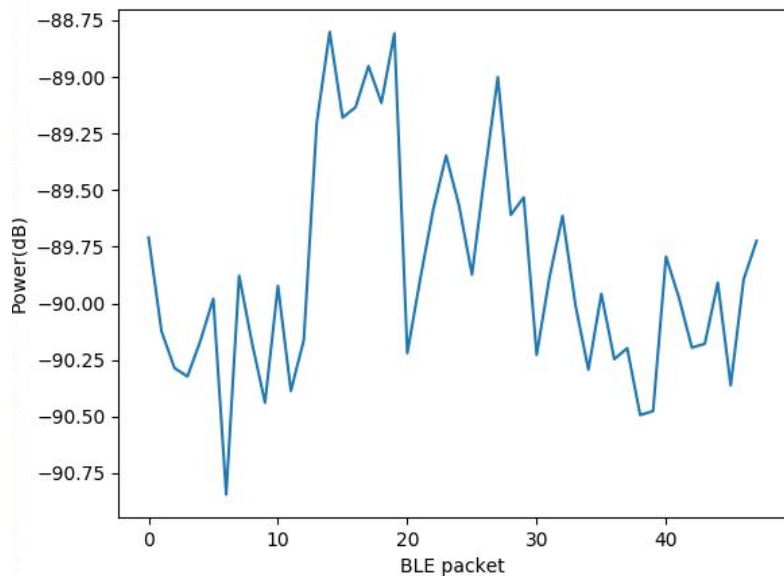
```
0000 00 ff ff 00 d6 be 89 8e 37 3c d6 be 89 8e 40 10 ..... 7<....@
0010 e7 da 3c d0 89 69 02 01 1a 02 0a 01 03 03 0d 18 <<-<-i.....
0020 47 11 d5 ..... 6..
```



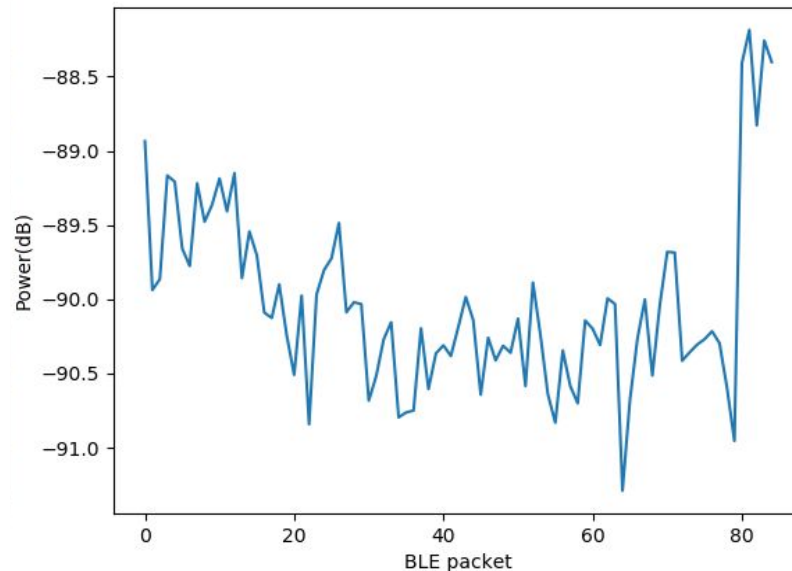
Project Results



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

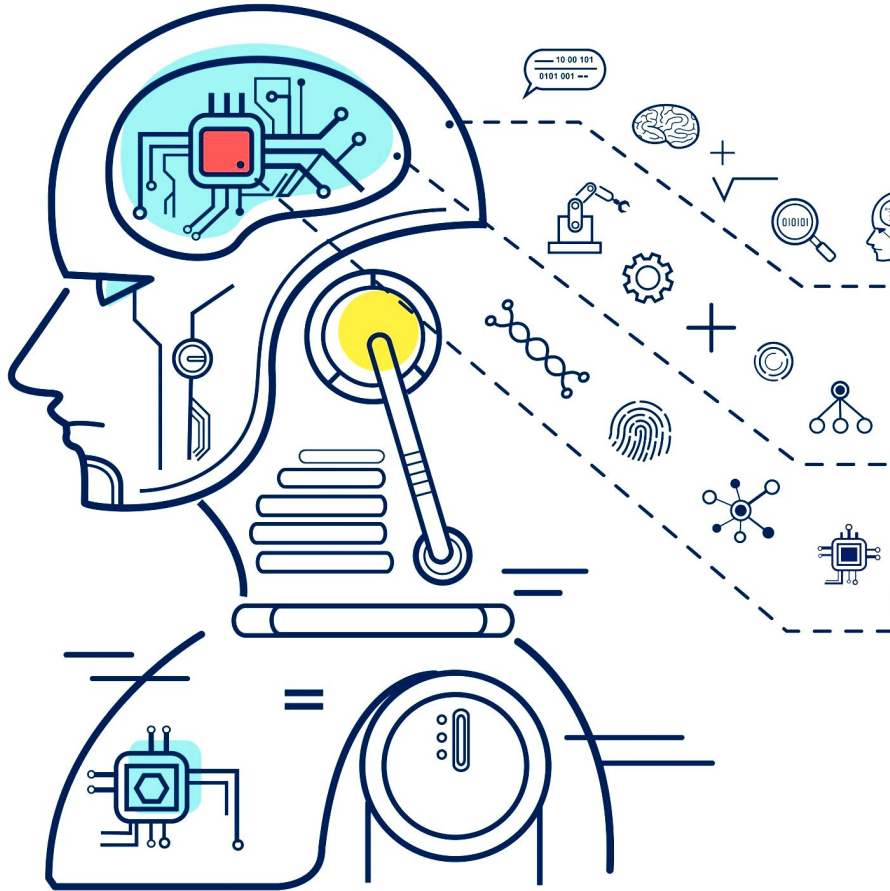
- **new IP** for our company to provide a secure way to localize and authenticate IoT devices
- **authentication of autonomous vehicles** or robots in a **building** according to their localization
- **driven by industry recent needs**
- working for few months in the development of a **Software Defined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

A screenshot of the iMinds Authority web interface. The header is pink with navigation links for 'Home', 'Documentation', and 'About'. The main content area is white and displays a welcome message for 'alexisd'. Below this, there is a 'User Certificate' section with two buttons: 'Download Login certificate' and 'Download PKCS12 certificate'. A warning message states that the certificate expires on 2022-09-04 18:04:08 and provides instructions for renewal. The 'Projects' section shows a list of projects: 'iMinds' and 'iMINDSCT', with a note that a membership request is pending for the following projects. At the bottom, there is a 'Getting started' section with a link to 'Join Project or Create New Project'.

Feedback



jFed CLI

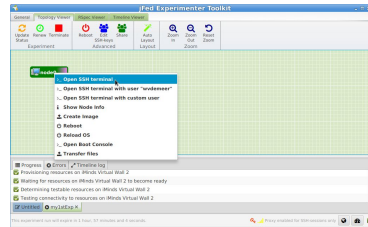
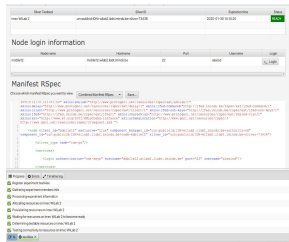
- Provision and manage experiment on testbeds
- Network and resource configuration
- Bootstrap an experiment
- Node provisioning takes a lot of time. Sometime fails
- Requested feature: place a reservation and book nodes with jFed CLI



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

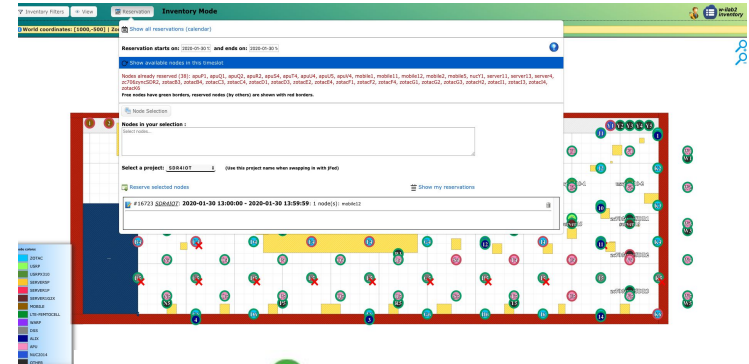
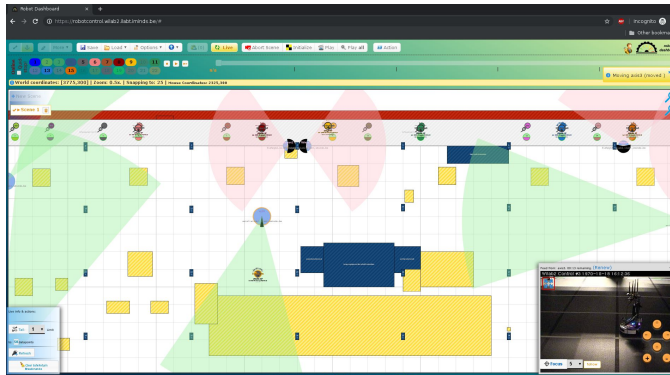


- UX could be improved.
- Quite unstable

Feedback

w-iLab.2 tools

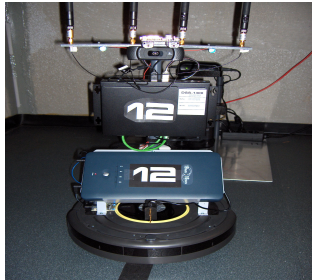
- Reservation Web UI
- RobotControl Web UI
- RobotController ruby script software



Feedback

w-iLab.2 nodes

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



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Co-funded by the
Swiss Confederation

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QUESTIONS

WWW.FED4FIRE.EU