

# Probr Demonstration – Visualizing Passive WiFi Data

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**Abstract**—Probr manages various types of WiFi capturing devices, collects captured WiFi traces, processes collected WiFi traces, and visualizes WiFi activities via its Web interface. In this demonstration, on-line analyses with live data are shown via its Web interface, presenting the following use cases: 1) device statistics, 2) room utilization, and 3) room heatmap.

## I. INTRODUCTION

Probr [11], [1] captures WiFi traces and provides live analyses and visualizations via its Web interface. WiFi traces are collected from capturing devices managed by Probr. For the Probr demonstration, 4 to 6 of such Probr-managed devices will be placed at the conference location and continuously capture passive WiFi data. The capturing devices will be small Raspberry-Pi like single-board computers as depicted in Fig. 1. These Odroid-C1 [2] devices are equipped with two WiFi antennas, one for capturing, and one for sending the collected data to the Probr server. Furthermore, other types of supported capturing devices are shown at our booth.

Live analyses and visualizations from the captured WiFi traces will be demonstrated via the Probr Web interface. Thereby, the following use cases will be covered:

- 1) **Device statistics.** Which device vendors are preferred by conference attendees?
- 2) **Room utilization.** How many people are present in the Probr-equipped conference room?
- 3) **Room heatmap.** Where are most of the devices located in the Probr-equipped conference room?

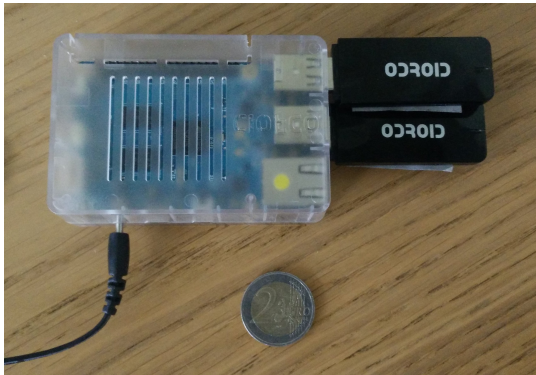


Fig. 1: Probr capturing device – Odroid-C1 [2]

## II. REQUIREMENTS

For a successful Probr demonstration and showcase, the following requirements are necessary:

- **Early access to the conference premises.** For setting up the devices, it is important to get access to the conference location early morning at the first day of the conference or the day before to install and place the Probr devices. It would be helpful if someone from the local team could be present during setup for technical guidance (*e.g.*, finding/showing power outlets).
- **WiFi access for the Probr capturing devices.** Each Probr capturing device needs an Internet connection to send the collected data to the Probr system for analysis. Thus, the WiFi credentials need to be known in advance.
- **One power outlet per capturing device.** Each Probr capturing device requires a power outlet nearby. The device uses a power adapter requiring 5V and 1.5A, thus, making it run with batteries is not possible. Type G power cables with a length of  $\sim 1$  meter are provided by us.
- **One table and one screen.** The bigger the screen, the better the Web interface of Probr can be shown. If screens are not available – although not optimal – the Web interface could be shown on our laptops.

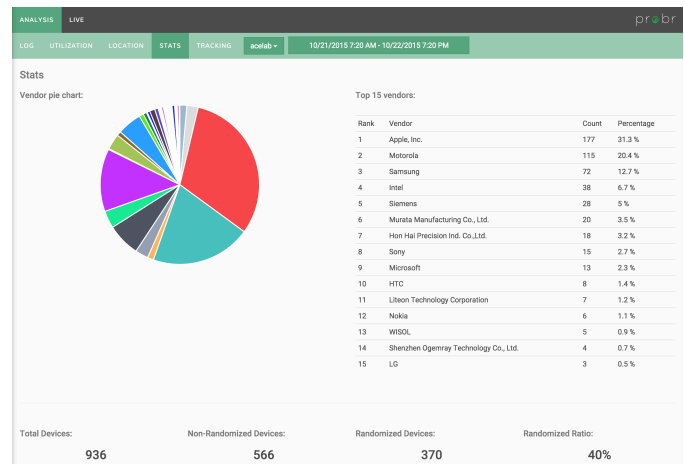


Fig. 2: Web interface, showing device vendor statistics

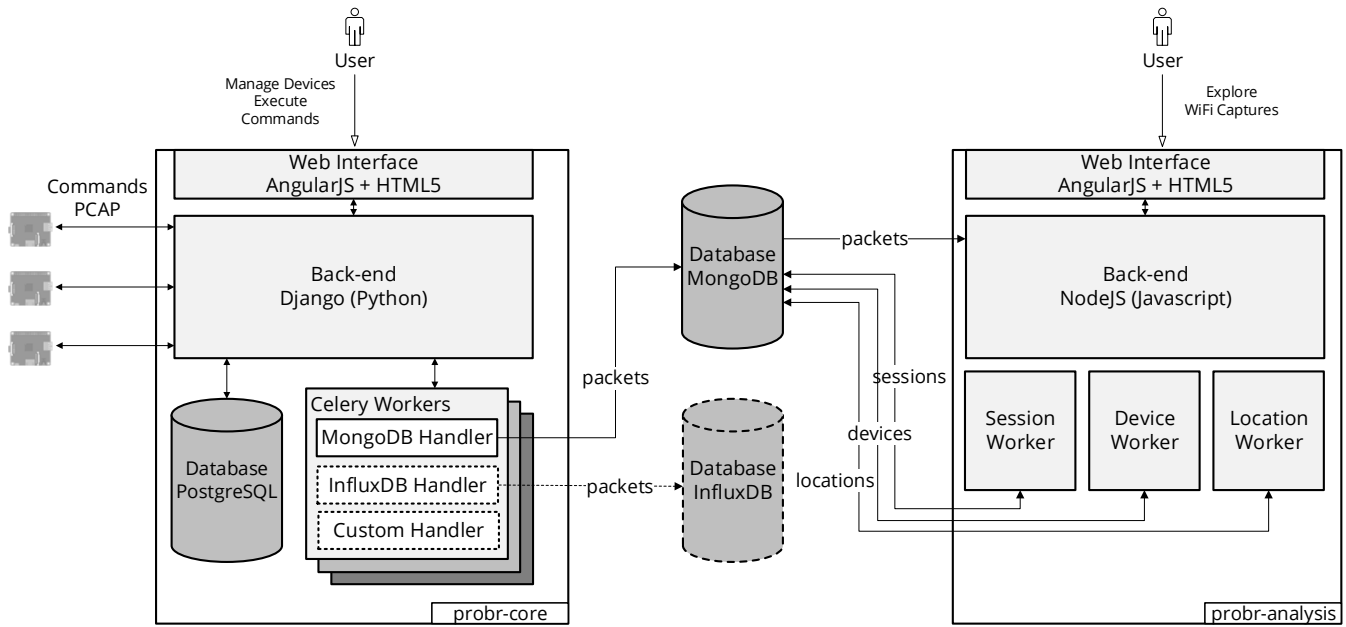


Fig. 3: Probr architecture

### III. DEMONSTRATION

The visitor at our table can see via the Probr Web interface which kind of WiFi data has been collected since the conference started.

For showcase 1) **device statistics**, the visitor can see the device statistics based on probe requests as shown in Fig. 2. This device vendor distribution reveals preferred manufacturers. Furthermore, if the visitor provides his/her MAC address (e.g., 5B:98:35:BA:67:95), Probr can list all known previous access point names that the visitor's phone is broadcasting. The visitor will be guided if he/she does not know how to lookup their MAC address. Newer smartphones do not reveal that much information anymore, but older phones do, and it is expected, that for older phones, the visitor may recognize names of previously used access points such as their university network or hotel network.

In the showcase 2) **room utilization**, the visitor can see via the Web interface how many people are currently in the room or at the conference as shown in Fig. 4. Which room(s) to measure depends where the Probr devices are placed. Probr can visualize the number of MAC addresses in that room giving an estimate on how many people are in the room if it is expected that every person in the room carries one device with WiFi enabled.

In the showcase 3) **room heatmap**, a heat map shows where WiFi devices are located. Depending on the placement of the Probr devices, it is expected to see patterns during coffee breaks and technical sessions. An example of such a heatmap is shown in Fig. 5.

If the visitor is interested in the device administration, a spare capturing device is available at our booth, where the device administration can be explained and how a device



Fig. 4: Web interface, showing room utilization

can be configured to become a Probr capturing device. Furthermore, grouping of Probr devices can be shown to make management easier. Device grouping is particularly powerful when combined with remote command execution shown in Fig. 6. A poster at our booth similar to Fig. 3 will illustrate the technical architecture for detailed discussion.

The data collected during the LCN 2016 conference is used for demonstration and scientific purposes only. The WiFi capturing will be limited to probe requests and thus does not include any potentially highly sensitive content from WiFi data packets. Furthermore, all Probr communication is encrypted and the Web interface is password protected. If requested, the data will be deleted after the demonstration.

TABLE I: Comparison of WiFi Tracking Tools [11]

	Snoopy [12]	Mo-Fi [10]	CreepyDOL [9]	Probr
Device Administration	No	No	No	Yes
Capturing Client	Python	Python	Ruby	Portable Shell
Data Presentation	Maltego (Data Visualization and Graphing Engine)	Web Interface with Visualizations	Unity (3D Game Engine)	Web Interface with Visualizations
Supported Use Cases	Room Utilization, Device Localization, Device Statistics, Person Tracking (all off-line)	Human Presence	Device Localization, Web Traffic Analysis	Room Utilization, Device Localization, Device Statistics, Person Tracking (all on-line)
Open Source	Mostly [3]	No	Partially [4]	Yes [5]

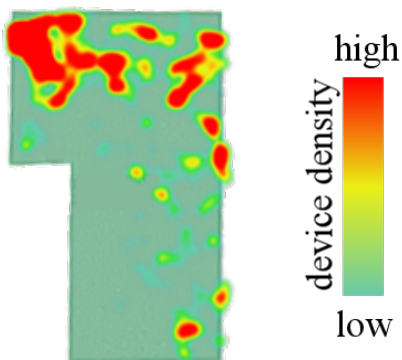


Fig. 5: Web interface, showing room heatmap

#### IV. NOVELTY

Probr is open source, available on Github [5], and supports the following use cases: Room Utilization, Device Localization, Device Statistics, Person Tracking. All of those use cases can be visualized on-line with live WiFi data aggregated from multiple capturing devices. Probr provides a Web interface for device administration and the capturing client is \*nix-shell compatible for maximum portability. Beyond the Odroid-C1s, other devices running different Linux distributions are shown at our booth. The intention of the demonstration is to highlight the novelty of Probr as outlined in Tab. I and to show how these use cases are supported by Probr.

Many existing tools work only offline (*e.g.*, WiPal [6]) and most commercial tools (*e.g.*, Acrylic WiFi Software [7] or Wi-Spy and Chanalyzer [8]) focus on WiFi network optimization (*e.g.*, Which environmental influence could interfere with WiFi networks?) rather than analysis use cases (*e.g.*, Where are most devices located in a monitored room?).

#### ACKNOWLEDGMENT

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#### REFERENCES

- [1] <http://probr.ch/>, last visited: Aug 2016
- [2] [http://www.hardkernel.com/main/products/prdt\\_info.php?g\\_code=G141578608433](http://www.hardkernel.com/main/products/prdt_info.php?g_code=G141578608433), last visited: Aug 2016

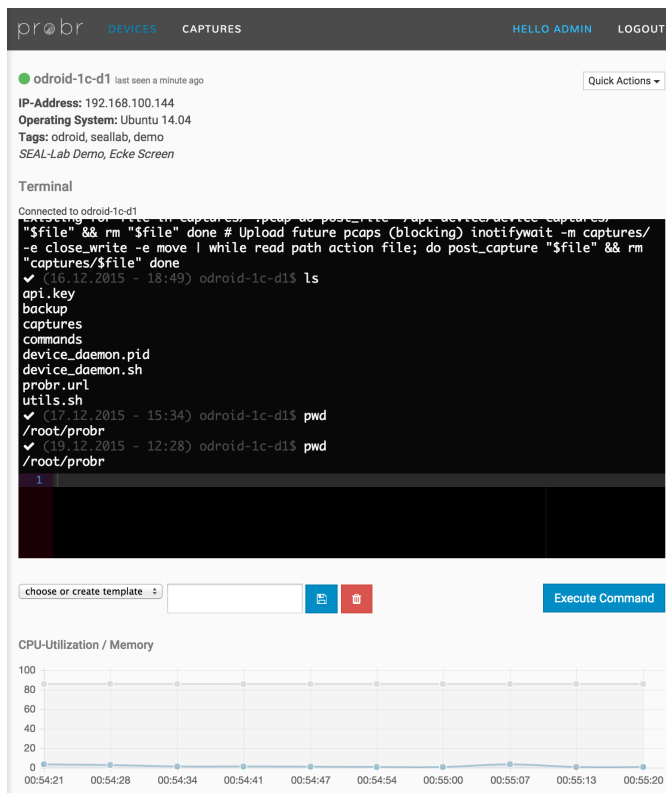


Fig. 6: Web interface, showing remote command execution

- [3] <https://github.com/sensepost/snoopy-ng>, last visited: Aug 2016
- [4] <https://github.com/ussjoin/reticle>, last visited: Aug 2016
- [5] <https://github.com/probr>, last visited: Aug 2016
- [6] <http://wipal.lip6.fr/>, last visited: Aug 2016
- [7] <https://www.acrylicwifi.com/en/wlan-software/>, last visited: Aug 2016
- [8] <http://www.metageek.com/products/wi-spy/>, last visited: Aug 2016
- [9] B.O'Connor: CreepyDOL: Cheap, Distributed Stalking. Technical Paper by Malice Afterthought, Inc (June 2013)
- [10] W.Qin, J.Zhang, B.Li, H.Zhu, Y.Sun: Mo-Fi: Discovering Human Presence Activity with Smartphones Using Non-intrusive Wi-Fi Sniffers. 10th IEEE International Conference on High Performance Computing and Communications (HPCC'13) pp. 2143–2150 (Nov 2013)
- [11] J.Scheuner, G.Mazlami, D.Schöni, S.Stephan, A.D.Carli, T.Bocek, B.Stiller: Probr – A Generic and Passive WiFi Tracking System. 41st IEEE Conference on Local Computer Networks (LCN) (Nov 2016)
- [12] G.Wilkinson: Digital Terrestrial Tracking: The Future of Surveillance. DEFCON 22 (2014)