PerSense Mobile Light

Middleware to Assist Small Data Capture

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UMOBILE established the main goal of developing a mobile-centric, service oriented architecture that efficiently delivers content and services to end-users. By efficiently it is meant that content/services are reliably available with the expected quality of service and despite any impairments of the communication infrastructure. UMOBILE decouples services from their origin locations, shifting the host-centric paradigm to a new paradigm, one that incorporates aspects from both information-centric and opportunistic networking with the ultimate purpose of delivering an architecture focused in: i) improving aspects of the existing infrastructure (e.g., keeping traffic local to lower delays and OPEX); ii) improving the social routine of Internet users via technology-mediated approaches; iii) extending the reach of services to areas with little or no infrastructure (e.g., remote areas, emergency situations).

Senception developed the PerSense Mobile Light application with the purpose to assist the UMOBILE project in gathering contextual information that could be relevant in the context of emergency scenarios to assist in the smooth deployment of the UMOBILE data transfer. This white paper explains the tool and how to use it.

1. Introduction

PerSense Mobile Light (PML)[1] is a light version tool of the PerSense ™ product line of Senception.
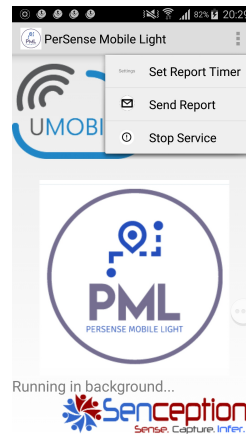
This light version aims solely at assisting researchers in easily gathering data concerning context derived from wireless roaming. The data captured is therefore derived from the natural networking footprint left around by devices.
Such data can then be relied upon to assist in inference of roaming habits in a seamless and secure way.

Released in UMOBILE in May 2015 under LGPLv3.0, PML captures information concerning a user's affinity network (contacts derived from Wi-Fi Direct and Bluetooth) as well as concerning roaming habits, over time and space (derived from Wi-Fi).

The tool has been developed to assist the research community in gathering meaningful traces and develop scientific studies, by reusing the collected

traces and is currently being used in studies worldwide.

Freely available for research purposes, PML can be extended upon request, and is one of the tools that is made available via the UMOBILE Lab.

2. PML in a Nutshell

PML stores all data locally on an SQLite database, for the period of one week, running in background. Additionally, each day the tool generates three different reports automatically (and statically) at a time previously selected by the user.

The reports are provided in csv format. The reports can be sent by e-mail by going to the PML menu, or can simply be obtained by checking the PML folder.

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1 Available in Android at
   https://play.google.com/store/apps/details?
   id=com.senception.tkiddo

2.1 Roaming Report

The **Roaming Diary report** provides sequential information (waypoints) concerning all Access Points (AP) crossed by the device.

Each row in the roaming diary report has the following fields: id, bssid, dayoftheweek, ssid, attractiveness, dateTime, latitude, longitude. id represents the sequential identifier of the AP waypoint crossed; ssid and bssid identify the AP; dayoftheweek is an integer corresponding to the day of the week, starting by Sunday (1), and ending with Saturday (7). *Attractiveness* is a binary field stating whether or not the device connected to the respective AP: if connected, attractiveness is set to 1; 0 otherwise. dateTime provides the day and time when the device entered the range of the AP. Latitude and longitude provide the coordinates of the device.

2.2 Affinity Network Report

The **affinity network report** provides information concerning peers that the device has had around over different days. Such sightings are derived from from Wi-Fi Direct[2].

The affinity network report provides a list of neighbors over time (affinity network). Each row has the following format: sequential identifier (*id*); identifier of the device (*uuid*); MAC address (*MAC*); date and time when the peer was last encountered (*dateTime*); GPS coordinates for the **current** device (*latitude, longitude*) when encountering the peer.

2.3 Visited Networks' Report

The **Visited Networks' report** provides information concerning visited networks, i.e., networks that the device has connected to. Each entry holds a tuple with the following fields: sequential identifier (id); hashed SSID (uuid); hashed MAC (mac); instant when the device first connected to the access point (timeon) and instant when the device connection stopped

(timeout); day of the week (1 corresponding to Sunday and 7 to Saturday); hour of the day (24 hour format).

3. Consent and Privacy Aspects

PML requires consent from the user to access Location (GPS coordinates); storage (local database); Wi-Fi connection information.

PML is set to provide high accuracy in terms of location, but works well if location services are set to low accuracy in order to spare battery.

The captured information is kept only on the device and concerns only wireless network data. Data such as MAC addresses, BSSIDs, SSIDs are obfuscated to assist in data anonymity.

> PML requires user consent to access Location; storage; Wi-Fi connection. All data is kept locally only, and all sensitive fields, such as MACs or SSIDs, are obfuscated.

4. How to Use PML Data?

PML is available via the Google App Store[3] for Android devices. After installing it, the time to generate reports daily has to be set. Such time can also be changed via the PML menu.
The application then generates data and stores it on the PML internal memory database.
The reports are stored under your device root storage, folder "PML_Reports".

There are 3 csv/zip folders:
- DD-MM-YYYY-waypoints-hashedMAC-pml.csv.
- DD-MM-YYYY-waypoints-hashedMAC-pml.csv.
- DD-MM-YYYY-visitednetworks-hashedMAC-pml.csv.

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2   The next PML version shall consider also Bluetooth sightings. Contact us for details, or if you want this version.

3   https://play.google.com/store/apps/details?id=com.senception.persenselight

The three different **daily** files can then be used with any data mining software.

The user can get the files directly, or send them via e-mail, by going to the menu and selecting "Send Report". This step will add the compressed files to a mail dialog.

6. References

[1]   Sarros, Christos-Alexandros; Diamantopoulos, Sotiris; Rene, Sergi; Psaras, Ioannis; Lertsinsrubtavee, Adisorn; Molina-Jimenez, Carlos; Mendes, Paulo; Sofia, Rute C.; Sathiaseelan, Arjuna; Pavlou, George; Crowcroft, Jon; Tsaoussidis, Vassilis. *Connecting the edges: A universal, mobile-centric opportunistic communications architecture*. inProc. IEEE Communications Magazine (Volume: 56, Issue: 2, Feb. 2018), pp 136-143, February 2018. DOI: 10.1109/MCOM.2018.1700325.

[2]   Rute C. Sofia, Igor Santos, José Soares, Sotiris Diamantopoulos, Christos-Alexandro Sarros, Dimitris Vardalis, Vassilis Tsaoussidis, and Angela d'Angelo. UMOBILE D4. 5: Report on Data Collection and Inference Models. UMOBILE Consortium, 2017.

[3]   Rute C. Sofia. "A Tool to Estimate Roaming Behavior in Wireless Architectures." In International Conference on Wired/Wireless Internet Communication, pp. 247-258. Springer, Cham, 2015.