Green Wi-Fi: Rethinking About Energy Savings On Smartphones From A Usage Perspective

Lunde Chen, Huan Li*, *Member, IEEE*

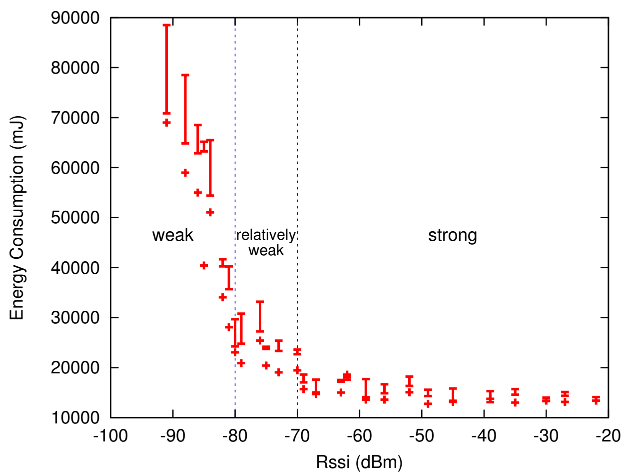

Fig. 1: Energy Consumption in different Rssi

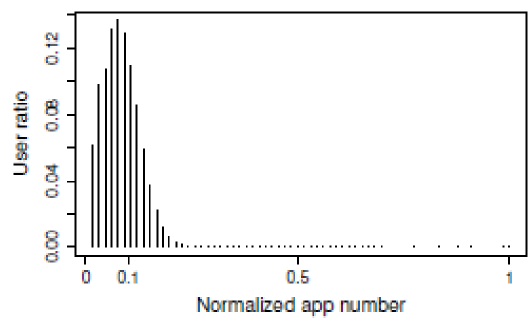

Fig. 2: User distribution of app diversity of Android phones [1]

***Abstract*—**

***Index Terms*—Rssi, Energy saving, Wi-Fi,**

I. Introduction

II. Wi-Fi Energy Consumption From A Usage Perspective

While the energy consumption of Wi-Fi can be modelled with packet-level information and other factors, we find that the dominating factor of Wi-Fi energy consumption comes from the bursts of traffic. For example, in our previous work of achieving energy saving of Wi-Fi regarding to Rssi, we found that Wi-Fi energy consumption can be seen as proportional to the time it takes to download a file.

As a result, to achieve energy saving, the key is that the bursts of data should be smart. We investigate the key factors that influence the burstness of Wi-Fi. We determine that Rssi, data scheduling and smartphone usage play important roles.

A. Rssi

B. Data Scheduling

For delay-tolerant data, batching them in a single burst can achieve significant energy saving. As we measured, downloading a file of 500 KB via HTTP cost the same energy as downloading 4 files of 500 KB, as shown in Figure 1. On the one hand, Wi-Fi has very high throughput, and mobile data is generally of small size [3]. On the other hand, 97% of mobile data is HTTP-based [3], which involves the initiation and the closure of HTTP connection, batching several HTTP data can make the time of download overlap. The overhead of maintaining multiple TCP connections can be ignored.

C. Smartphone Usage

As we found, when the smartphone is in usage, the energy cost of Wi-Fi interface is lower than when the phone is screen-locked. So we can exploit this for energy saving.

Applications with network permission could open the Wi-Fi interface periodically for little data transmission, even when the phone is screen-locked and not used. This could represent a huge amount of energy consumption, especially when many such applications are installed in the smartphone. However, as [1] shows, Android smartphone users usually use only 20% of their installed applications the most frequently, but rarely use other applications. So we could use Iptables to block the Internet access of these rarely-used applications to save energy.

III. Green Wi-Fi Design

A. Architecture

As shown in Fig. 3.

B. Decision Engine

The input of the decision engine: Rssi, Wi-Fi SSID, HTTP data size and their delay-tolerance, application usage history data, remained battery.

The intermediate output of the decision engine: FSM of Wi-Fi state, max throughput of Wi-Fi AP

The final output of the decision engine: Transfer data or not, which applications to block/unblock with Iptables.

*Corresponding Author: Dr. H. Li (email: lihuan@buaa.edu.cn), is with the School of Computer Science and Engineering, Beihang University, Beijing, China 100191.

L. Chen is with with the School of Computer Science and Engineering and Ecole Centrale de Pékin, Beihang University, Beijing, China 100191.

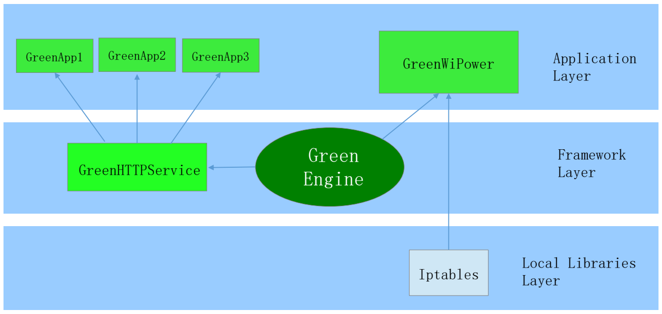

Fig. 3: Architecture of Green Wi-Fi

C. Implementation

Implementation: The Green Engine, the GreenHTTPService framework, multiple test applications GreenApp1, GreenApp2, GreenApp3 ... and also GreenWiPower which blocks the Internet access of rarely-used applications installed by a specific user.

IV. Experimental Results

Comparision of battery lifetime with and without Green Wi-Fi.

V. Related Work

VI. Conclusions

Acknowledgement

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