NTraX: A Network Traffic Capturing and Remote Profiling Framework for Crowd-Sourcing Mobile User Data

Sean Mead
Department of Computer Science
Central Michigan University
Mount Pleasant, MI 48859
mead1sm@cmich.edu

Patrick Seeling
Department of Computer Science
Central Michigan University
Mount Pleasant, MI 48859
pseeling@ieee.org

***Abstract*—In this demonstration, we present the NTraX mobile application and server-side processing framework for profiling of mobile device network utilization. The NTraX mobile application component allows fine grained capturing of network activity on the mobile device without negative battery impacts. Submission of the captured data to the remote server allows for server-side processing and profiling (for individual users and anonymously amongst users), ultimately resulting in recommendations to the user how to optimize their communications strategically while providing a rich anonymous dataset for mobile optimizations.**

***Index Terms*—Mobile communication; Energy consumption; Network traffic; Android**

I. Introduction

In recent years, the amount of data that mobile users consume has increased significantly. Current predictions indicate a continuation of this trend for years to come [1]. As the network interfaces of mobile devices typically consume most of the limited battery power available, see, e.g., [2], the correlation between the amounts of data, related user interactions and limited battery power has spurred research efforts that investigate the possibilities of energy efficient mobile data delivery. As indicated by prior research efforts, mobile applications feature characteristic behaviors with respect to their network utilization. The periodic nature of mobile application updates has attracted specific attention, see, e.g., [3]. The CasCap approach outlined in [4], for example, utilizes mobile device clones in the cloud to optimize the network traffic.

Additional energy and networking efficiency can be realized by users themselves if they utilize their mobile devices strategically. Our NtraX mobile application is used to monitor a mobile device's data consumption behavior (in its current state by application and network interface and connection type) and provide the user with a graphical representation of the amount of data utilized using 'cards' as main user interface elements. The application captures the information at a fine granularity (individual minute intervals) without significant impact on the battery power consumption. Basic information about a mobile device's network utilization by applications and interfaces is provided from the locally stored data, similar to the Android system built-in functionalities.

Please direct correspondence to P. Seeling

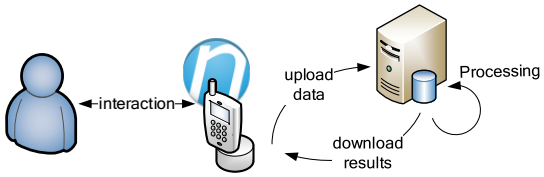

Fig. 1. System overview of the mobile NTraX application and the server-side advanced processing. Server-side functionality can be added transparently and is subsequently 'pushed' to the user device.

The NtraX mobile application represents only the client side that executes on the mobile device – a cloud-based component will enhance the functionality of the client side and will provide an overall data usage analysis framework in the future. We illustrate the interplay in Figure 1.

The cloud side will receive (periodically or on user demand) the mobile device's data and provide advanced analysis (ultimately in clear text), which is then transferred back to the device, where the user can retrieve it. The cloud-based component will initially be used to store historical data of individual users, but incrementally be enhanced with additional features, such as the evaluation of usage patterns or the (anonymous) comparison of data amongst users.

The card-based user interface design allows for generally intuitive interactivity, but even more importantly it allows for the transparent addition of server-side features, which are subsequently 'pushed' to the client in form new cards to be displayed, e.g., as clear text recommendations to adjust the cellular usage at certain times of the day, and so on.

II. Demonstration

In the demonstration, we will present the mobile application and its workflow, see the example in Figure 2, which highlights the card-based interaction. We will then demonstrate the uploading of user data into the user-specific (and protected) server-side framework, where the advanced processing will

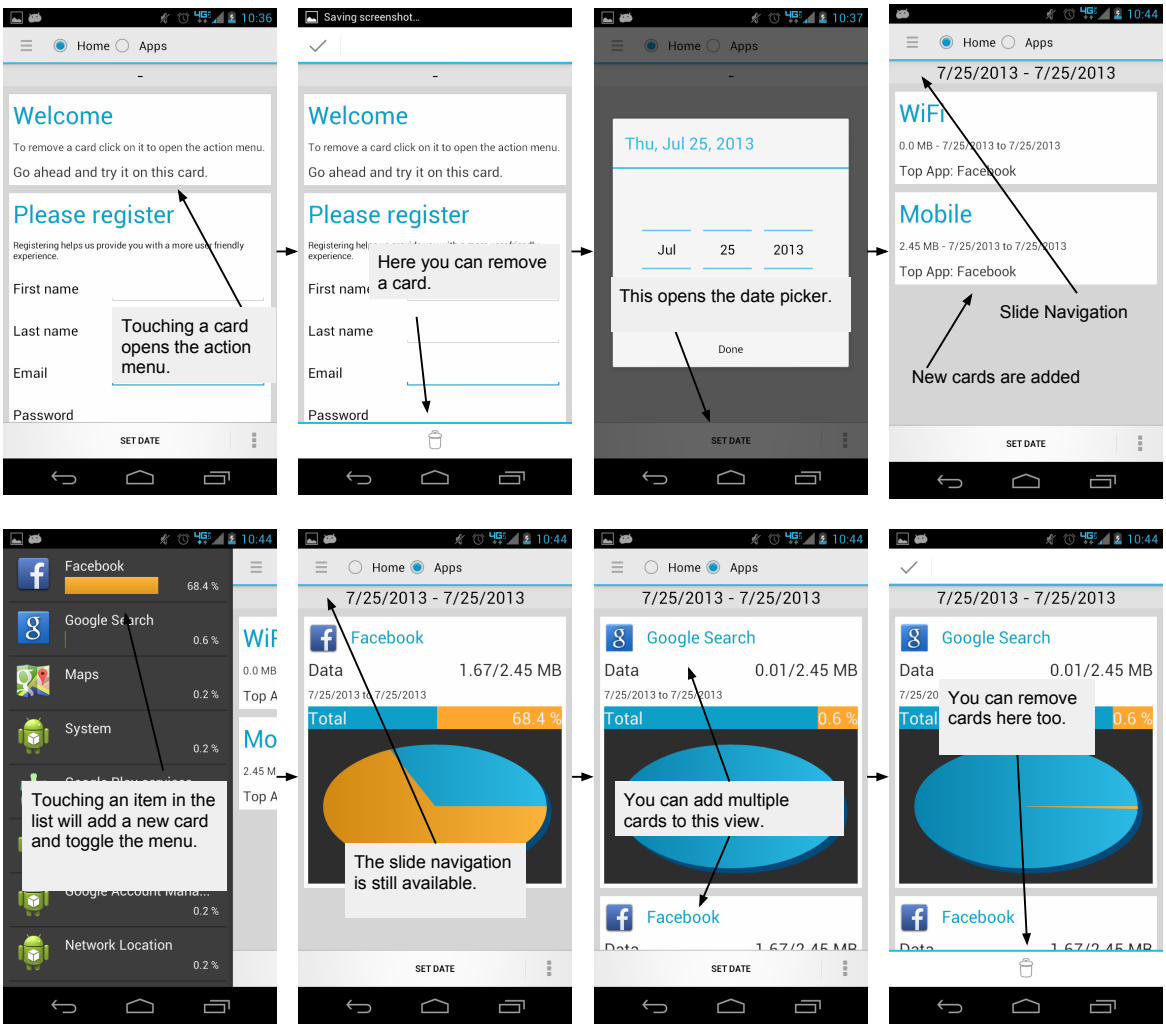

Fig. 2. Interaction example from the mobile user's point of view. Interaction takes place via a mainly card based interface that allows for transparent feature additions.

take place. We will walk through the process of the data processing on the server and how results are being 'pushed' back to the mobile client application as card to be shown to the user.

We will continue the demonstration by walking through the long-term prospect of this framework and additional features that we will add over time and how those can be realized. Specifically, we will describe how as an additional outcome, this project has the potential to deliver large-scale fine-grained anonymous user network data to the research community.

Acknowledgment

This work was supported in part by an Early Career grant from the Office of Research and Sponsored Programs at Central Michigan University.

References

[1] Cisco, "Cisco visual networking index: Global mobile data traffic forecast update, 2011–2016," Feb. 2012.

[2] A. Carroll and G. Heiser, "An analysis of power consumption in a smartphone," in *Proceedings of the 2010 USENIX Annual Technical Conference (ATC)*. Boston, MA: USENIX Association, 2010, pp. 21–34.

[3] F. Qian, Z. Wang, Y. Gao, J. Huang, A. Gerber, Z. Mao, S. Sen, and O. Spatscheck, "Periodic transfers in mobile applications: network-wide origin, impact, and optimization," in *Proceedings of the 21st international conference on World Wide Web*, ser. WWW '12. New York, NY, USA: ACM, 2012, pp. 51–60. [Online]. Available: http://doi.acm.org/10.1145/2187836.2187844

[4] Y. Xiao, P. Hui, P. Savolainen, and A. Ylaaaski, "Cascap: cloud-assisted context-aware power management for mobile devices," in *Proceedings of the second international workshop on Mobile cloud computing and services*. ACM, 2011, pp. 13–18.