Upgrading Wireless Home Routers as Emergency Cloudlet: A Runtime Measurement

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Abstract. Smartphones have become a daily companion in recent years due to their small form factor. However, such mobile systems are resource-constrained in view of computational power, storage and battery life. Offloading resource-intensive tasks (aka mobile cloud computing) to distant (e.g., cloud computing) or closely located data centers (e.g., cloudlet) overcomes these issues. However, in emergency case (e.g., blackout) conventional offloading concepts are no longer available while battery life of mobile devices becomes crucial. In this paper, we extend our previous concept of upgrading wireless home routers as cloudlets by an emergency power extension (i.e., off-the-shelf battery pack) to provide computing infrastructure during an emergency case. Our conducted runtime measurements show the feasibility of this concept. As preliminary result, we are able to run a large-scale deployable emergency cloudlet over 5 hours autarchically under full load.

Key words: wireless home router, mobile cloud computing, cloudlet, smartphones, offloading, blackout, emergency case

1 Introduction

Most mobile services today rely on mobile cloud computing [1], i.e., offloading resource-intensive tasks to distant (e.g., cloud computing) or closely located servers (e.g., cloudlet [4]), to save mobile resources (e.g., battery). However, in emergency cases (e.g., blackout) these offloading systems might not be available anymore if battery life of mobile devices becomes crucial. Cloudlets are predestinated for emergency cases or hostile environments [5] due to the close proximity to the consumer, i.e., cloudlets provide a direct low-latency and high-bandwidth connection without the need of a network infrastructure. However, a large-scale deployment of autarkic cloudlets is still lacking. To address this challenge we extend our router-based cloudlet [2] as large-scale deployable emergency cloudlet, i.e., we equip an upgraded wireless router with an emergency care (i.e., off-the-shelf battery pack). In this paper, we show the feasibility of the proposed concept by conducting runtime measurements. Our preliminary results show a prototype that runs over 5 hours autarchically under full load. However, for a promising
large-scale deployment of emergency cloudlets either household owners need to upgrade their routers or manufacturers could provide the emergency mode inherently. The remainder of this paper is organized as follows: First, we describe our concept of cloudlets for emergency cases; second, we present the preliminary results. This paper closes with conclusion and outlook of future works.

2 Router-based Emergency Cloudlets

In [2], we proposed router-based cloudlets to offload computations from mobile device. This concept benefits from the dense distribution of wireless routers, low latency, high bandwidth and economic operations. However, in some emergency cases like blackouts current offloading systems are no longer available. While wireless home routers provide adequate offloading performance (cf. [2]), they also have lower power drain. This makes our approach predestinated to realize an emergency infrastructure. To realize a prototype we equip a router-based cloudlet with an off-the-shelf battery pack. Upgrading a router-based cloudlet as emergency cloudlet can be done by the household owner himself or inherently by the manufacturer. In [3], we already proposed and discussed an emergency switch for wireless home routers to build a mesh network with other upgraded routers for an emergency communication infrastructure. Combining all approaches, emergency cloudlets are able to autarkically operate during blackouts and provide an emergency infrastructure including both computational offloading and communication capabilities. Highly relevant for data analyses and communication between first responders and victims in disaster scenarios. In the next section, we evaluate how long an emergency infrastructure can be maintained by our approach and what the requirements are.

3 Preliminary Results

Proving our concept we conduct runtime measurements over various CPU usages of the router (cf. Figure 1). Our experimental setup consists of a mobile device (LG Nexus 5) and an upgraded wireless home router (Asus RT-AC87U) as emergency cloudlet providing computational power and running autarchically through 18,000mAh, 19V off-the-shelf battery pack (Aukey PB-016) at a price of $\sim 60$. For reproducible results, we permanently run one resource-intensive task on the router to achieve maximal CPU usage constantly. To measure various maximal usage levels we accordingly limit the maximal CPU usage of that computation process by Linux command \texttt{cpulimit}. Connecting the mobile device has two reasons: firstly, simulation of offloading device by exchanging data packets, and secondly, measuring router’s runtime, i.e., mobile device starts the measurement run by triggering the task on the router with fully charged battery pack and stops the run by detecting inaccessibility of the router when the battery is empty. Our preliminary results show an autarchic router runtime over 5 hours under full load and almost 7 hours in standby mode (cf. Figure 1).
4 Conclusion and Future Work

In this paper, we extended our previous concept of upgrading wireless home routers as cloudlets [2] by an emergency power mode (i.e., off-the-shelf battery pack) to provide a large-scale emergency computing infrastructure. Proving our concept we conducted runtime measurements over various CPU usages. Our preliminary results show the feasibility of this concept and an adequate runtime of our emergency cloudlet over 5 hours autarchically under full load. Enough to temporarily provide an alternative offloading system and bridge short-term emergency cases like blackouts. In future works, we will connect emergency cloudlets as computing mesh network and create energy models of router-based cloudlets.

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References