Introduction

Power consumption of smartphones has been an issue since the very beginning of their production. In addition, it is becoming more and more challenging to solve this issue as smartphones become an indispensable component of our daily activities. In this work, we propose a novel architecture to dramatically ameliorate energy efficiency for uplink transmissions, while achieving near-optimal throughput and high fairness levels.

Cooperative Dual-radio Architecture

We propose an architecture which leverages cooperative communications [1] and opportunistic scheduling [2] to boost the energy efficiency of uplink cellular communications (i.e., LTE). Figure 1 is a depiction of our proposed architecture. We exploit the availability of a secondary radio interface (i.e., WiFi) to form clusters among smartphones. Cluster members use this secondary interface to forward their traffic to the cluster head, i.e., the cluster member with the best channel quality to the base station at that instant.

Mobiles benefit from this architecture because they can forward part of the LTE traffic over WiFi interface. Since the transmission cost in LTE is much higher than WiFi, the reduction of LTE transmissions can highly improve the energy efficiency of the mobile, as shown in Table I.

Results

We consider an LTE-like uplink scheme, using 20 MHz bandwidth and operating in FDD mode, with stationary Rayleigh fading. For simplicity, we categorize the users into three predefined user channel quality classes, namely, poor, average, and good. The mean achievable rates for poor, average, and good users are 20%, 50%, and 80% of the maximum transmission rate achievable in the system, respectively.

Table I: power consumption of LTE and WiFi devices

<table>
<thead>
<tr>
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<th>LTE</th>
<th>WiFi</th>
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<tbody>
<tr>
<td>Base power</td>
<td>Transmission power</td>
<td>Base power</td>
</tr>
<tr>
<td>1.29 [W]</td>
<td>51.97 [nW/bps]</td>
<td>0.28 [W]</td>
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We derive the power consumption of mobiles from the empirical power models proposed for LTE and WiFi in [3] and [4], respectively. The resulting power consumption of a device consists of: (i) a baseline power consumption of each of the two wireless interfaces; (ii) the power spent for LTE transmission by cluster heads; (iii) the power spent for WiFi reception by cluster heads; and (iv) the power spent for WiFi transmission by cluster members.

Reference