Optimal Joint Scheduling and Cloud Offloading for Mobile Applications

Cloud offloading is an indispensable solution to supporting computationally demanding applications on resource constrained mobile devices. In this paper, we introduce the concept of wireless aware joint scheduling and computation offloading (JSCO) for multi component applications, where an optimal decision is made on which components need to be offloaded as well as the scheduling order of these components. The JSCO approach allows for more degrees of freedom in the solution by moving away from a compiler predetermined scheduling order for the components towards a more wireless aware scheduling order. For some component dependency graph structures, the proposed algorithm can shorten execution times by parallel processing appropriate components in the mobile and cloud. We define a net utility that trades-off the energy saved by the mobile, subject to constraints on the communication delay, overall application execution time, and component precedence ordering. The linear optimization problem is solved using real data measurements obtained from running multi-component applications on an HTC smart phone and the Amazon EC2, using Wi-Fi for cloud offloading. The performance is further analyzed using various component dependency graph topologies and sizes. Results show that the energy saved increases with longer application runtime deadline, higher wireless rates, and smaller offload data sizes.