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ENERGY EFFICIENCY FOR MOBILE USING CLOUD AND STOCHASTIC WIRELESS CHANNEL WITH DEADLINE

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Abstract

In this platform, a mobile application can be executed either on the mobile device or on the cloudlet. The design objective is to develop an optimal application-execution policy, minimizing the energy consumed by the mobile device. To conserve energy for the resource-constrained mobile device, we optimally execute the mobile applications either the mobile device or the cloud platform. This system refers the energy-efficiency of mobile cloud computing using stochastic wireless channel with deadline. We use both scheduling problems such as optimal mobile execution and cloud execution and obtain closed-form solutions for optimal scheduling policies, we derive a threshold policy it states that the data consumption rate, defined as the ratio between the data size (W) and the delay constraint (T), is compared to a threshold which depends on both the energy consumption model and the wireless channel model. Finally, for the mobile execution, we minimize the computation energy by dynamically (running the application) configuring the clock frequency of the chip. For the cloud execution, we minimize the transmission energy by optimally scheduling data transmission across the stochastic wireless channel. Mathematically, we model the minimum-energy task scheduling problem as a constrained stochastic shortest path problem on a directed acyclic graph. Closed-form solutions were obtained for both scheduling problems to decide the optimal application-execution condition under which either the mobile execution or the cloud execution is more energy-efficient for the mobile device. In this we used stochastic wireless channel to effective transmission of data from transmitter to receiver. And it has advantages like fast fading, no shadowing and change phase and velocity depends on the data. In this paper we evaluate execution of mobile and cloud and transmission time also. And dynamic scaling with mobile is calculated by using Gillbert-Elliot model. The transmission energy of mobile is saved by using the stochastic wireless channel.

Introduction

The tension between resource-hungry applications and resource-poor mobile devices is considered as one of the driving forces for the evolution of mobile platforms. Due to the limited physical size, mobile devices are inherently resource-constrained, equipped with a limited supply of resources in computation, energy, bandwidth and storage. In particular, the energy supply from the limited battery capacity has been one of the most challenging design issues for mobile devices. The limited battery life has been found by market research as the biggest complaint for smart phones. Therefore, resource limitations in the mobile devices should be considered for the design of the mobile applications. Emerging cloud-computing technology, owing to its elastic resource allocation from a shared pool, offers an opportunity to extend the capabilities of mobile devices for energy hungry applications. Various cloud-assisted mobile platforms have been proposed, such as Cloudlet, Clone Cloud and Weblet. In these proposed platforms, each mobile device is associated with a system-level clone called cloud clone in the cloud infrastructure. The cloud clone, which runs on a virtual machine (VM), can execute mobile applications on behalf of the mobile device - commonly referred as application offloading. This architecture requires both a mechanism to implement application offloading and a policy to decide when to offload applications. For the former, existing research has proposed various architectures and mechanisms for offloading applications to the cloud. For the latter, the research on optimal energy policies for application offloading to cloud execution is rather inadequate, in that a fixed data rate model for wireless transmission is normally assumed. Each mobile device is replicated by a system-level clone that runs on a virtual machine (VM). The VM is located in a nearby cloud infrastructure and can migrate in response to the user’s location. Moreover, the cloud clone regularly synchronizes its state with the physical mobile device. The cloud clone not only provides computing and storage in its local VM environment, but also harnesses computing and storage resources from a remote cloud.

Mobile cloud computing

Mobile Cloud Computing (MCC) has revolutionized the way in which mobile subscribers across the globe leverage services on the go. The mobile devices have evolved from mere devices that enabled voice calls only a few years back to smart devices that enable the user to access value added services anytime, anywhere. MCC integrates cloud computing into the mobile environment and overcomes obstacles related to performance (e.g. battery life, storage, and bandwidth), environment (e.g. heterogeneity, scalability, availability) and security (e.g. reliability and privacy). Delivering cloud services in a mobile environment brings numerous challenges and problems.

Mobile systems, such as smart phones, have become the primary computing platform for many users. Various studies have

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identified longer battery lifetime as the most desired feature of such systems. A 2005 study of users in 15 countries found longer battery life to be more important than all other features, including cameras or storage. A survey last year by Change Wave Research revealed short battery life to be the most disliked characteristic of Apple's iPhone 3GS, while a 2009 Nokia poll showed that battery life was the top concern of music phone users.

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In mobile computing platform information between processing units flows through wireless channels. The processing units (client in client/server paradigm) are free from temporal and spatial constraints. That is, a processing unit (client) is free to move about in the space while being connected to the server. This temporal and spatial freedom provides a powerful facility allowing users to reach the data site (site where the desired data is stored) and the processing site (the geographical location where a processing must be performed) from anywhere. This capability allows organizations to set their offices at any location. The discipline of mobile computing has its origin in Personal Communications Services (PCS). PCS refers to a wide variety of wireless access and personal mobility services provided through a small terminal (e.g., cell phone), with the goal of enabling communications at any time, at any place.

Cloud execution energy model

In this research, we make some assumptions for the cloud execution. First, we assume the binary executable file for the application has been replicated on the cloud clone initially. As such, it does not incur additional energy cost. Second, we assume a stochastic fading model for the wireless channel between the mobile device and the cloud clone. It is characterized by a channel gain of g and a noise power of N. A specific model for the channel gain (Gilbert-Elliott model). Third, the receiving power is a constant. As such, we do not consider the scheduling of the output results from the cloud, but the optimal scheduling of input data transmission in order to achieve the minimum energy consumption on the mobile device. In addition, we have not considered any security issue on the cloud-assisted platform, thus the extra energy caused by additional operations concerning security, e.g., encryption and trust checking, is not taken into account. Indicates that since there is no closed-form expression between time delay and the power in the wireless networks, approximating models should be built for the practical system design. In this paper, we adopt an empirical transmission energy model. Specifically, for a wireless fading channel with a gain of g, the energy consumed to transfer s bits of data over the channel within a time slot is governed by a convex monomial function, i.e.,

$$\mathcal{E}_t(s, g, n) = \lambda \frac{s^n}{g}$$

Where n denotes the monomial order, and λ denotes the energy coefficient. This monomial function has been widely used. The energy-bit relation can be well approximated by the monomial function. The monomial function can be fairly close to the capacity-based power model by choosing an appropriate coefficient λ and order n. Such a monomial function can produce the analytical solution for the optimization problem of the cloud execution. We set λ = 1.5 so that the energy consumption is consistent with the measurements. When the application is executed by the cloud clone, the energy consumed by the mobile device depends on the amount of data to be transmitted from the mobile device to the cloud clone and the wireless channel model. For a mobile application A (L, T), L bits of data needs to be transmitted to the cloud clone within T. The total energy consumption on the mobile device for

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cloud execution is Et (st, gt, n), where st and gt are the number of bits transmitted and channel state in time slot t, respectively. For the cloud execution, its total energy consumption can be minimized by optimally varying the data rate (the number of transmitted bits in a given time slot), in response to a stochastic channel. Since the energy cost per time slot is a convex function of bits transmitted, it is ideal to transmit as few bits as possible However, reducing the number of bits transmitted per time slot increases the total delay for the application. Therefore, there exists an optimal transmission data-rate schedule to minimize the total transmission energy, while satisfying the delay requirement. Under the optimal transmission scheduling, the minimum amount of transmission energy for the cloud execution is given by

$$\mathcal{E}_c^* = \min_{\phi \in \Phi} \mathbb{E}\{\mathcal{E}_c(L, T, \phi)\}$$

whereφ = {s1, s2, ...sT } denotes a data transmission schedule that meets the delay deadline (T time slots), Φ is the set of all feasible data scheduling vectors, and Ec(L, T, φ) denotes the transmission energy. It should be noted that the expectation of energy consumption is taken for different channel states.

Optimal transmission energy under cloud execution

In this section, we consider the problem of data scheduling to minimize the transmission energy under cloud execution, with a deadline constraint. We choose to simplify the formulation by not considering the power of receiving data on mobile device, since it is constant and often smaller compared to the transmitting power. We can ignore the time delay of receiving output data if the data is small1. In addition, we if the output data is large, we can approximate the delay deadline of the data transmission as the total deadline subtracted by the constant term of output receiving time assume the display and network interface of the mobile device can be turned off when it is idle during the cloud execution. Hence, we only consider the optimal scheduling of input data transmission for the cloud execution.

Stochastic wireless channel

At the microscopic level, channels are stochastic event with probabilities of turning on and off. With the advent of patch clamping and other experimental procedures, it is possible to record from a single channel while stepping through many different voltages. Here I will look at some simple and then more complex models. First, let's consider for example the potassium channel for the Morris-Lecar model. The current for this is:

$$I_K = g\,n\,(V - E_K)$$

The gate n just satisfies the first order kinetic scheme:

$$\overset{\alpha}{\underset{\beta}{\rightleftharpoons}} O$$

The rates are voltage dependent. However, for a fixed value of the voltage, they are fixed. We simulate the stochastic process as follows. We choose a time step, dt and choose a random number, r between 0 and 1. If we are in the closed state C and alpha dt > r then we jump to the open state. Otherwise, we stay at the closed state. Similarly, if we are in the open state O and beta dt > r then we jump to the closed state.

The transfer of real-time data over the Internet and channels in heterogeneous packet networks is subject to errors of various types. A packet can be corrupted and therefore is unusable for a voice or video decoder—due to unrecoverable bit failures. On wireless and mobile links temporary and long lasting reductions in the available capacity frequently occur and even in fixed and wired network sectors packets may be dropped at routers and switches in phases of overload.

Adaptive power control is an important technique to select the transmission power of a wireless system according to channel condition to achieve better network performance in terms of higher data rate or spectrum efficiency. While there has been some recent work on power allocation over stochastic channels the problem of optimal adaptive power allocation across multiple stochastic channels with memory is challenging and poorly understood. In this paper, we analyze a simple but fundamental problem. We consider a wireless system operating on two stochastically identical independent parallel transmission channels, each modeled as a slotted Gilbert-Elliott channel (i.e. described by two-state Markov chains, with a bad state "0" and a good state "1"). Our objective is to allocate the limited power budget to the two channels dynamically so as to maximize the expected discounted number of bits transmitted over time. Since the channel state is unknown when power allocation decision is made, this problem is more challenging than it looks like.

Energy consumption is a major challenge in wireless sensor network .Most of the routing algorithms focus on energy efficient paths. For the analysis of such algorithms at low cost and in less time; we believe that simulation gives the better approximation. We address transmission of data with deadline constraints over a wireless fading channel. Specifically, the system

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model consists of a wireless transmitter with data packets arriving to its queue having strict deadline constraints. The transmitter can control the transmission rate over time and the expended power depends on both the chosen rate and the present channel state. The objective is to obtain a rate-control policy that serves the data to meet the deadline constraints while also minimizing the transmission energy expenditure. Using a novel approach based on cumulative curves methodology and continuous-time stochastic control formulation, we obtain the optimal transmission policy under various specific scenarios. Utilizing these results, we then present an energy-efficient policy for the case of arbitrary packet arrivals and deadline constraints, and also give simulation results comparing its performance with a non-adaptive scheme.

Traditional routing protocols are not designed as per the specific requirement of wsn. Therefore energy efficient routing paradigms are as area of active research. Power aware routing protocols make routing decisions based on power energy related of minimum total transmission energy and total working time of the network can be mutually contradictory.

The terms slow and fast fading refer to the rate at which the magnitude and phase change imposed by the channel on the signal changes. The coherence time is a measure of the minimum time required for the magnitude change or phase change of the channel to become uncorrelated from its previous value.

Slow fading arises when the coherence time of the channel is large relative to the delay constraint of the channel. In this regime, the amplitude and phase change imposed by the channel can be considered roughly constant over the period of use. Slow fading can be caused by events such as shadowing, where a large obstruction such as a hill or large building obscures the main signal path between the transmitter and the receiver. The received power change caused by shadowing is often modeled using a log-normal distribution with a standard deviation according to the log-distance path loss model.

Fast fading occurs when the coherence time of the channel is small relative to the delay constraint of the channel. In this regime, the amplitude and phase change imposed by the channel varies considerably over the period of use.

To reduce power consumption and ensure locating accuracy at the same time, many approaches have tried to reduce the frequency of GPS sampling and dynamically select among the alternative location-sensing mechanisms with the aid of less power intensive sensors such as compass and accelerometer. Beyond the action of locating, some application-related methods used before or after locating are also proposed in recent years, such as management of multiple LBAs to reduce overall location querying and trajectory simplification to reduce transmission. These methods attempt to make a better use of the existing locating technologies of GPS, WiFi and GSM and completely depend on the resources on mobile platforms, which is called standalone schemes. By leveraging outer resources, researchers also put forward many ideas to get new energy-efficient locating technologies. Inspired by the training and mapping mode of Wi-Fi locating, history-based mapping schemes have been explored to use the storage.

Conclusion

This project investigated the problem of how to conserve energy for the resource-constrained mobile device, by optimally executing mobile applications in either the mobile device or the cloud clone. In this Project developed a frame work for energy-optimal mobile cloud computing under stochastic wireless channel. For the mobile execution, we minimize the computation energy by dynamically configuring the clock frequency of the chip. For the cloud execution, to minimize the transmission energy by optimally scheduling data transmission across the stochastic wireless channel. Closed-form solutions were obtained for both scheduling problems to decide the optimal application-execution condition under which either the mobile execution or the cloud execution is more energy-efficient for the mobile device. To derived a threshold policy for mobile applications with small output data. The threshold depends on the wireless transmission model and the ratio of energy coefficients for the mobile execution and the cloud execution. A significant amount of energy can be saved by offloading mobile applications to the cloud within the deadline.

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