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A Survey on QOS Guaranteed Bandwidth Shifting and Redistribution in Mobile Cloud Environment

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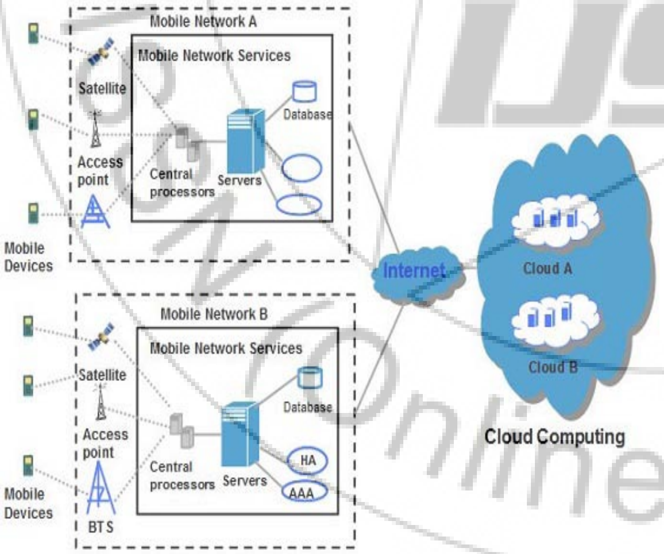
Abstract: ***Mobile Cloud Computing (MCC) is an integration of cloud computing in the mobile environment which is used to improve the overall performance of the mobile devices. Mobile Cloud Computing faces a number of challenges both in mobile side and computing side, one of which is providing Quality-of Service (QoS), even if the interfacing gateway changes due to the mobility of the users Mobile devices are roaming over the network and switching the interfacing gateways they connect to. This results into change in quality of service. Due to node mobility, bandwidth shifting is required for providing QoS-guarantee to the mobile nodes. However, shifting alone is not always sufficient for maintaining the QoS-guarantee because of varying spectral efficiency across the associated channels, coupled with the corresponding protocol overhead involved with the computation of utility so that we are formulating bandwidth redistribution as a utility maximization problem, and solves it using a modified descending bid auction. For this purpose we are using Auction based bandwidth redistribution (AQUM) algorithm. In the auction process, each gateway participates as a bidder and the Cloud service provider (CSP) acts as an auctioneercum-seller. We use descending price auction for determining the optimum bandwidth allocation—this maximizes the utility vector.***

Keywords: Cloud service provider, Mobile cloud computing, Quality of service, Bandwidth shifting, Bandwidth Redistribution

1. Introduction

Cloud computing is computing in which large groups of remote servers are networked to allow the centralized data storage, and online access to computer services or resources. Clouds can be classified as public, private or hybrid.

Mobile cloud computing (MCC*)* at its simplest, refers to an infrastructure where both the data storage and data processing happen outside of the mobile device.



Mobile cloud applications move the computing power and data storage away from the mobile devices and into powerful and centralized computing platforms located in clouds, which are then accessed over the wireless connection based on a thin native client.

In case of high computational resource and application requirements such as video streaming, audio, and data services, the mobile users request services from the cloud servers through an interfacing gateway. The gateway communicates with the cloud service provider (CSP) for allocating shared resources which are required for resolving the mobile user's request. Thereafter, connection is set up between the mobile user and the cloud server through the interfacing gateway, and, then, the mobile user is capacitated to use the resources of the cloud servers.

2. Motivation

MCC is the state-of-the-art mobile computing technology that aims to augment a multitude of mobile devices, especially Smartphone's and alleviate their resource poverty. Mobile users can have access to their applications, data, and cloud services through the Internet by leveraging mobile web.While mobile devices roaming over the network interfacing gateway changes to maintain the connectivity with cloud. Therefore, the aggregated bandwidth requirement for the gateway also changes, which creates the necessity of bandwidth shifting, provided the previous allocation was optimal.. Further we need bandwidth redistribution among the interfacing gateways for maximizing utility among the interfacing gateways. So from this we can say interfacing gateways are responsible for providing quality of service.

3. Literature Survey

There are many reasons to use cloud computing with mobile applications. MCC provides some solutions to the obstacles which mobile subscribers are usually face up with [2]. Mcc reduces some obstacles but with increasing use of Mcc there are certain challenges present at mobile network side , some of these of obstacles are Low bandwidth, Network availability, Network Heterogeneity(WCDMA, GPRS, WiMax) ,Pricing [2].

Heterogeneity [1] in MCC is the existence of differentiated hardware, architectures, infrastructure, and technologies of mobile devices, clouds, and wireless networks. The cutting edge technologies are expected to initiate and facilitate collaboration among these heterogeneous computing devices toward unrestricted mobile computing.

Heterogeneity in Mobile Devices: Software, hardware, and technology variation among mobile devices cause heterogeneity in this domain. Moreover, increasing popularity of smartphones creates a dynamic and demanding market that disperse them to different dimensions, e.g. brand, hardware, OS, feature, and communication medium. Consequently, device-level collaboration becomes more challenging in MCC.

Heterogeneity in Clouds: Numerous cloud vendors provide different services with custom-built policies, infrastructures, platforms, and APIs that make the cloud landscape heterogeneous. Such variations cause interoperability and portability as major challenges in cloud computing. There is a notion that business competition also diversifies cloud providers with their heterogeneous frameworks, exacerbating heterogeneity on the cloud side.

Heterogeneity in Wireless Networks: In MCC, the majority of communications take place in the wireless network environment which is a heterogeneous communication medium. Variations in wireless networks and their related technologies impact the delivery of cloud services and affect mobility, augmentation, and usability of smartphones .

Quality of service provision in mobile cloud computing [3] is a challenge to overcome. In MCC, mobile users need to access the servers located in a cloud when requesting services and resources in the cloud. However, the mobile users may face some problems such as congestion due to the limitation of wireless bandwidths, network delay, network disconnection, and the signal attenuation due to mobile users' mobility. They cause delays when users want to communicate with the cloud, so QoS is reduced significantly. There are several research issues in MCC, which are related to quality of service to the mobile cloud computing.

Low Bandwidth:
Bandwidth is one of the major issues in MCC because the radio resource for wireless networks is much scarce as compared with the traditional wired networks.

Availability
Service availability becomes more important issue in MCC than that in the cloud computing with wired networks. Mobile users unable to connect to the cloud to access service because of traffic congestion, network failures, and the out-of-signal.

Unreliable Physical Channels
Wireless channels are highly unreliable and also have restricted bandwidth. Wireless channels have high packet loss ratio and also have bit error rate due to fading and multipath effects. The wireless medium has been shared by multiple stations so that the bandwidth allocation to one station will be affected by the neighboring stations.

Node Mobility
Mobile devices are roaming over the network and switching the wireless networks they connect to. In order to provide a continuous service, the mobile device must be able to connect to the wireless network that is available. For e.g.; a mobile phone may be switch from one cell covered by one base station to another cell covered by another based station. Also it has switched from the cellular phone network to a Wireless LAN.

Auction is well known for modeling buying and selling of commodities and services. Similarly, auction theory is also useful for exchanging commodities in the network applications [7]. Apart from other auctions such as Sealed-Bid, Open-Cry, First-Price, and Second-Price, conventional auction is more popular in the context of exchanging network commodities due to its simplicity. Conventional auction is mainly classified into two categories based on the bidding schemes—ascending or descending bid auction. We are going to use descending bid auction in our project to solve the problem of bandwidth redistribution.

4. Preliminaries

The two basic concepts that we are going to use here are Spectral efficiency of channel and Auction theory

Spectral efficiency of a channel
Spectrum efficiency or bandwidth efficiency refers to the information rate that can be transmitted over a given bandwidth in a specific communication system. It is a measure of how efficiently a limited frequency spectrum is utilized by the physical layer protocol, and sometimes by the media access control.

According to the Shannon capacity theory [8], the maximum rate of channel capacity (c) in an additive white Gaussian noise (AWGN) channel is expressed as

$$c = B\log_2(1 + \frac{1}{N_0 B})$$

where B, P and N0 define the channel bandwidth, transmit power, and power spectral density of the noise, respectively. Therefore, the largest possible spectral efficiency of a channel for reliable communication is obtained from Shannon's spectral efficiency (Esh) as follows:

$$E_{sh} = \frac{c}{B} = \log_2\left(1 + \frac{P}{N_0 B}\right) = \log 2(1 + \gamma)$$

Where, g is the signal to noise power ratio (SNR) at the receiver.
In MCC, each gateway may use adaptive modulation scheme for adjusting their transmission rate depending on channel quality. Therefore, the spectral efficiency (E) relative to the theoretical maximum efficiency is expressed by Goldsmith and Chua as

$$E = log_2\ (1 + \Psi\gamma)$$

Depending on the requirements of a specific application, the target

$$\Psi = \frac{1.5}{\ln(0.2/BER^{trgt})}$$

Auction Theory

Auction theory is an applied branch of economics which deals with how people act in auction markets and researches the properties of auction markets. There are many possible designs (or sets of rules) for an auction and typical issues studied by auction theorists include the efficiency of a given auction design, optimal and equilibrium bidding strategies, and revenue comparison. Auction theory is also used as a tool to inform the design of real-world auctions; most notably auctions for the privatization of public-sector companies or the sale of licenses for use of the electromagnetic spectrum. Conventional auction is mainly classified into two categories based on the bidding schemes—ascending or descending bid auction. We use the auction theory-based approach for solving the QoS-guaranteed bandwidth redistribution problem in MCC.

5. Proposed work

We formulate bandwidth redistribution as a utility maximization problem. We are looking to solve it using a modified descending bid auction.
In the proposed scheme, named as AQUM, each gateway aggregates the demands of all the connecting mobile nodes and makes a bid for the required amount of bandwidth.

AQUM (Auction-Based QoS-Guaranteed Utility Maximization)

An auction is a mechanism or a set of business rules for exchanging commodities based on the bidding price. Therefore, we use the auction theory-based approach for solving the QoS-guaranteed bandwidth redistribution problem in MCC, following the methodology similar to the one described in [7]. In the auction process, each gateway participates as a bidder, and the CSP acts as an auctioneercum- seller. We use descending price auction for determining the optimum bandwidth allocation—this maximizes the utility vector. In descending price auction, the seller sets the initial ceiling price for each unit allocation, and decreases the price over time until either the price becomes zero or any buyer accepts the price for buying the commodity. In this problem, we consider a tradeoff between the unit price and the bandwidth request, as; in general, the requested amount of bandwidth reduces with the increase in price per unit allocation. For incorporating the tradeoff condition, we modified the termination condition of the descending price auction. In our modified descending price auction process, the price decreases over time until the total bid reaches the total available bandwidth. In the interim, if the price p becomes less then pmin, the ceiling price is reset again for continuing the auction process. We describe the basic steps of the modified descending price auction for the present problem.

Initialization: Each gateway Gi knows its Shannon spectral efficiency Ei, protocol overhead αi, and revenue per unit service delay Ri. Here we are looking to calculate the revenue per unit service delay depending upon the quality of service they are providing to us , and to calculate this revenue per unit service delay we are proposing a method depending on quality of service and

At start CSP Broadcast Its reserve bid β, CSP also broadcast price p per unit allocation to all the gateways and also sets the initial value p as Pmax.

Bid: Each gateway Gi submits a bid bi(0<bi<Btot) which represents the minimum required bandwidth at the initial stage required for the QoS-guarantee constraint. Submitted bid by the gateway G_i should satisfy the service delay constraint, which considers the requests of all mobile nodes and the minimum bandwidth requirement for performing its own operation. Hence, the bid amount is computed as

$$b_i = \sum_{k=1}^{N_i} bik + \Phi_i$$

Where Φ_i represents the minimum requirement of bandwidth to maintain its own operation to provide a quality of service. After every iteration the bid is increased by CSP by some positive value δ.

$$b_i(t+1) = b_i(t) + \delta$$

Allocation: In each iteration, CSP aggregates all the bid values and adds the aggregated value to its own reserve bid β. Finally, the CSP compares the compute value with the maximum availability of bandwidth then the CSP concludes the auction process, and allocates Bandwidth to the gateway. For maintaining the total available bandwidth equals to allocated bandwidth we allocate Bi amount of bandwidth instead of bi, where Bi is calculated as.

$$B_i = \frac{b_i(t)}{\sum_{i=1}^{I} b_i(t)}(B_{tot} - \beta)$$

Payment: The gateway Gi pays the cost value Ci to the Cloud service provider for the allocation of bandwidth bi units by adopting the Pre-pay mechanism.
Ci calculated as follows

$$C_i = p_{bi}$$

AQUM Algorithm

Input: P_{max}, β
Output: B
CSP broadcast P(t) to all gateways
Gateway calculates b(t) and U(t)
For i=0 to I do
If ($U_i(t) > U_i(t-1)$) then
Gateway Gi submits bid b_i(t)

Else
Gateway Gi submits bid $b_i(t-1)$
End if
End for
If $(\sum_{i=1}^{I} b_i(t) + \beta \geq B_{tot})$ then
CSP calculates B and allocates to gateways
CSP confirms the final price p(t) to all gateways
Else
CSP receives the price p(t+1)=P(t)-Δ
If (p(t+1)<P_{min})) then
CSP reset the price p(t+1)=P_{max}
End if
Go to step 1 for next iteration
End if

Where
Gi-Gateway
Ui-Utility fucntion of each gateway
Pmax- maximum selling price
Bi- bid value
Btot- available bandwidth

We are looking to improve the bidding process by allowing the payment gateways to know the bidding value of other payment gateways.

6. Conclusion and Future Work

Several research works carried out towards the development of quality-of-service provision in MCC has been discussed in the previous section. However, there are still some issues which need to be addressed and improved. In this section the possible research directions towards the development of quality-of-service provision in MCC and the future research direction of general MCC issues are discussed.

Some issues like Mobile devices has limited storage and processing capacity so work in direction of to how efficient use of these limited resources can be performed for cloud computing can be done. Various operating systems are available for mobile devices like Android, Symbian, and Chrome etc. So work related to does a general access platform for mobile cloud computing is possible on top of these various operating system platform can be done. In future the research related to security can be done as there are various security threats both inside and outside the cloud.

Mobility is one of the general issues because of user mobility and due to the unreliable wireless channel status. In Future, research should be focused on the design of a unique framework that integrates the existing solutions and activates the most suitable services based on the clients requirement, current mobile device, cloud server status and network.

We have proposed an auction-based QoS-guaranteed utility maximization algorithm for maximizing the revenue of each gateway, while it maintains QoS of mobile nodes by purchasing bandwidth from the service provider.
Even though the proposed algorithm, AQUM, maximizes the utility for redistribution of bandwidth, which, in real environment, is not always feasible. A distributed algorithm, therefore, is necessary.

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