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AUCTION BASED NETWORK SELECTION FOR MULTIMEDIA APPLICATIONS

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ABSTRACT

Multimedia application have emerged to be one of the most future applications. The Purpose of this paper is to select the best network in a heterogeneous environment and to distribute the bandwidth resources to the user based on multi-media applications in the game theory techniques(Auction game). This paper presents the framework of characterizing multimedia applications and their communication requirements. In the traditional method Network Selection is based on RSS (Received Signal Strength). However, RSS only is not enough to satisfy the various demands of different users and different multimedia applications. Though some methods have considered multiple criteria (e.g. QoS, RSS, Utility function, Bandwidth, User Preference) for selecting the best network. Therefore user requests bandwidth for multimedia applications there is a need to have mechanisms to decide which network is the best suitable network for each user at each moment in time for every application that the user requires. We do not only consider the utility of users but also model the network operators' utility and discuss the truth telling behaviour of network operators in terms of offered prices and service quality.One of the challenging problems is to choose the optimal network depending upon the type of the application user going to be used. Best network selection considers the factors such as Cost, Quality and Energy. It also deals with multimedia applications to distribute the bandwidth resource to the users according to their application requests.

Keywords: *RSS, WLAN, RAN, WIMAX*

1. INTRODUCTION

In the ever-evolving heterogeneous environment a significant growth has been enhanced. Network operators have started to deploy different RAN (Radio access Networks) and different network technologies such as WLAN(Wireless local Area Network) WIMAX(Worldwide interoperability for microwave access). There is a growing demand for online services such as browsing, shopping, music downloads, banking, file transfer. The aim is to provide seamless, transparent, QOS-enabled connectivity to the user by taking in to account the limitations of the underlying wireless access technology and user preferences. In this paper we concentrate on the user network selection decision which accounts for a large number of the new data services. For example the user may make a voice over ip call or send an e-mail or make huge amount of data transfer or uploading a streaming video these services may require characteristic requirements, session duration, bandwidth required and QOS parameters (Jitter, delay etc.) Users need to decide which currently available RAN is most suitable for their required service given their terminal equipment capability, their data transfer requirements, and their communications budget [9].Best network is to be selected by analyzing their characteristic requirements. In particular auction game are well suited for achieving Resource Allocation in this environment.[7].Other papers dealing with applications of game theory to resource allocation problems include[2] [7] [10].

2. MULTIMEDIA APPLICATION REQUESTS FROM USER

The following are some of the multimedia application where the user requests:

2.1 VoIP

VOIP is a low-bandwidth application that is very sensitive to delay and jitter but can withstand some packet loss. Transport cost factor is considered negligible because of low bandwidth usage. Also because of low bandwidth requirements, total and available bandwidth are not issues. Since there is some correlation of utilization with jitter and delay, it is preferred to have low utilization for the selected network.

2.2 Streaming

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Being a multimedia service, a streaming application requires a higher bandwidth than VoIP. Therefore, available bandwidth, transport cost, and current utilization are important factors. It is less vulnerable to delay and jitter than VoIP because of the ability to buffer longer duration of data before playback. Sensitivity to packet loss is similar to VoIP.

2.3Web Browsing

A Web browsing application is a low QoS service; the importance of utilization, delay, jitter, and packet loss is low. It does not need a guaranteed bit rate because of the spiky nature of Web traffic patterns. With statistical traffic multiplexing for such traffic, broadband wireless networks can deliver a reasonable customer experience even at lower average data rates. The total bandwidth and allowed bandwidth are therefore less critical, but transport cost is considered critical [12].

3. GAME THEORY AND NETWORK TECHNOLOGIES

Game theory is the study of strategic decision making. . A game consists of a set of players, a set of moves or strategies available to those players, and a specification of payoffs for each combination of strategies.[8]. There are two types of game .They are as follows: Non Co-operative Game: It is a game in which one player makes decision independently. Co-operative Game: Group of players may work together to maximize their payoff.

WLAN: Wireless local area network connects two or more devices within a room with a wireless distribution and usually provides a connection through an access point to the wider Internet.

WIMAX: WiMax covers up to 65 kms and it is a worldwide interoperability for microwave access.

4. SYSTEM ARCHITECTURE

Typically, system architecture has the following phases:

4.1 Network Detection Manager

The role of the Network Detection Manager is to scan the surrounding area and to provide a list of the available networks from the pool of networks and provide their characteristics to the Network Filter. A basic minimum/maximum threshold is defined for the main criteria for each application type.[11].

4.2 Network Selection Utility Function

The utility function task is to select the best network by considering the parameters such as Energy, Quality and cost.

4.3 Auction Game

After selecting the best network the auction game takes place. The networks are directly connected to IP Backbone Network. A Decision Maker (DM) resides in the IP Backbone Network. Decision Maker receives and updates user requests and Network information and context.

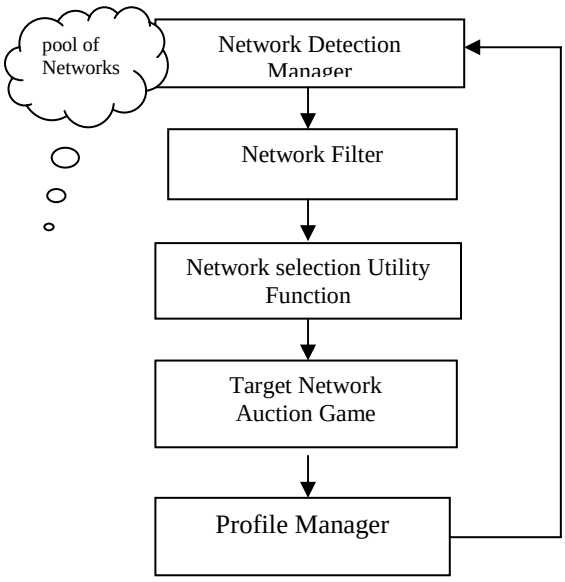

Fig.1system Architecture

Auction Game Takes Place Through The Equation

$$b^{a}_{\omega,o}(\gamma_q, \theta_k) = ((\gamma_q, \theta_k), \pi^{a}_{\omega,o}) \quad (1)$$

Where $b^{a}_{w,o}(\gamma,\theta_k)$ is bid offer from the operator o through network technology w in an area a against the application required bandwidth γ_q. Associated attribute vector is represented by θ_k and a $\pi^{a}_{w,o}$ is per unit bandwidth payment(cost).

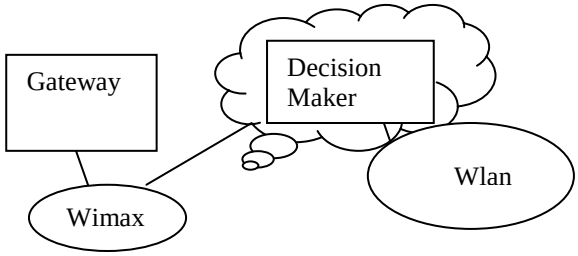

Figure.2 Interworking Architecture

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Operator utility function is defined by

$$U_{\omega,o}(\gamma,\theta_k)=\begin{cases}(\gamma_q,\theta_k)\pi^{\alpha}_{\omega,o}-\sum_{k\epsilon\theta}C_{\omega,o}(\theta_k) & \text{if } D\le b_{\omega}(\theta_k)\\ \{\lambda((\gamma_q,\theta_k)\pi^{\alpha}_{\omega,o}-\sum_{k\epsilon\theta}C_{\omega,o}(\theta_k)) & \text{if } D=b_{\omega}(\theta_k)\\ 0 & \text{if } D\ge b_{\omega}(\theta_k)\end{cases} \quad (2)$$

Where $c_{w,o}(\theta_k)$ is the cost incurred on a single attribute value. $\sum_{k\epsilon\theta}$ $c_{w,o}(\theta_k)$ is the operators' reservation price for service[3].

4.4 Profile Manager

The Profile Manager module keeps track of the user profile, device profile, application requirements, and operator profile.

5. PROPOSED NETWORK SELECTION PARAMETERS FOR FINDING BEST NETWORK

The parameters that are considered for finding the best network are defined as follows:

RxSS : The strength of the signal received by user from the network.

Cost (C) : The actual operating cost of the network.

Band width (BW) : The total amount of available band width for the data of the network.

User Requirement (P): User Requirement is that they offer the application or services such as Browsing, streaming, VoIP, Data Transfer, Uploading photos, videos, etc

The network selection function can be defined also by the overall utility functions such as Energy, Cost, and Quality. The overall utility function is defined by

$$U_i = \emptyset_i \cdot [u_{e_i}^{w_e} \cdot u_{q_i}^{w_q} \cdot u_{c_i}^{w_c}] \quad (3)$$

Where U is the overall utility for RAN i.$\varphi_i \epsilon [0,1]$ is network reputation factor of the RAN .u_e,u_q,u_c are the utility functions defined for energy, quality, cost .$w_e+w_q+w_c=1$,where w_e, w_q, w_c are the weights for the considered criteria.

5.1 Energy Utility

The estimated energy can be defined by equation[4]

$$E = t\,(r_t + Th_{req}\ r_d) + C \quad (4)$$

T -> Transaction time

r_t -> Energy consumption per unit of time

Th_{req} ->Required throughput

c->Constant

The Energy utility is given by

$$U_e = \frac{E_{MAX}-E}{E_{MAX}-E_{MIN}},\ E_{MIN}<=E<E_{MAX} \quad (5)$$

$E<E_{MIN}$ =1, Otherwise 0

E_{MIN} -> Minimun energy consumption

E_{MAX}-> Maximum energy consumption

5.2 Quality Utility

The Quality Utility function is given by

$$U_q = \{1 - e^{\frac{-\alpha\cdot Th^2}{\beta+Th}},\quad Th_{MIN}<=Th<Th_{MAX} \quad (6)$$

$Th<Th_{MIN}$ = 0, Otherwise 1

Th -> Average Throughput

α and β -> parameters that determine the shape of the utility function.

5.3 Cost Utility

The Cost Utility function is given by

$$U_c = \frac{C_{MAX}-C}{C_{MAX}-C_{MIN}},C_{MIN}<=C<C_{MAX} \quad (7)$$

$C<C_{MIN}$ =1 ,Otherwise 0

C -> monetary cost of the network

C_{MIN} -> Minimum cost of the network that the user can pay,C_{MAX}-> Maximum Cost of the network that the user can afford to pay.

6. NETWORK SELECTION WITH RESPECT TO ITS ATTRIBUTES AND PARAMETERS

The attributes that are used in our network selection model are as follows:

Reputation: It is a user perceived satisfaction where the user prefers the network that has the lowest delay and jitter for the requested application type.

Cost: It is the price offered by the access network for the service that is requested.

Offered Bit Rate: Bit rate is the transmission of the data or receiving the data. When the user is near the base station the data can transmit in a faster rate compared to the user far away from the base station.

Mobility Support: It plays an important role in the selection of appropriate network. wimax has the greater mobility support as it covers large area when compared to WLAN.

User Payment Plan: In the proposed network selection model there are three plans for the payment of user. They are as follows:

Pay as you go: The objective of pay as you go is that it requires low cost and would have acceptable QOS.

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Pay monthly: The objective is that it has good QOS and the cost is fixed.
Business: The objective is that it has excellent QOS but the cost is within the budget.

Table1: Attribute Score Per Payment plan

Score	Pay as you go	Pay monthly	Business
1	Cost	Reputation	Bit rate
3	Reputation	Bit rate	Cost
5	Bit rate	Mobility	Reputation
7	Mobility	Cost	Mobility

7. BANDWIDTH ALLOCATION USING AUCTION BASED GAME FOR MULTIMEDIA APPLICATIONS

The Auction Game [13] is a game theoretic approach that models the situation in which bidders submit bids to an auctioneer in order to obtain a certain object or service. The good is sold to the bidder that submits the highest bid.Auctioning is a common way of allocating resources to users using a central agent[5]. Bandwidth is demanded by the users to the base stations by submitting bids. Bandwidth is distributed to the users in proportion to the bids after the bidding process is completed. The Resource is allocated to user who wins the highest bid.

7.1Types of Auction There are three types of auctions. They are as follows:

7.1.1 Live Open Outcry Auction

The auctioneer stands before an audience, usually at the property, calling for higher bids. The process is fully transparent with bidders competing in the open at a present time and place. The winning bidder signs contract of sale at the conclusion of the auction sale.

7.1.2 Sealed bid Auction

Bids are submitted in a sealed format on a predetermined date and time. Typically used when the property is difficult to value or there may only be few buyers whose bids may vary significantly.

7.1.3 Hybrid Auction

Combines the features of both the sealed bid and the open outcry auction. Sealed bids are initially due on a specific date and selected bidders are invited to an exclusive open outcry auction.

8. SIMULATION MODEL AND RESULTS

In the simulation first describes about the network selection utility function where the parameters such as Energy, Quality and Cost is being calculated. The user average revenue and the network reputation is estimated for the three cases:

First Case: It is a quality oriented user where user prefers high quality over low energy and cost (W_q=0.6,W_e=0.2,W_c=0.2) shown in Figure.3.

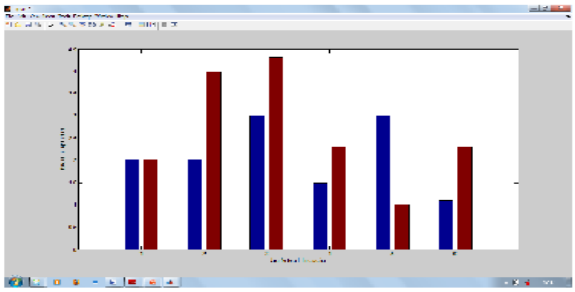

Figure3. Quality oriented user where user prefers high quality over low energy and cost

Second Case: In the Second case it is a energy oriented user where user has prefers low energy but the cost and energy is high (W_q=0.2,W_e=0.6,W_c=0.2) shown in Figure.4.

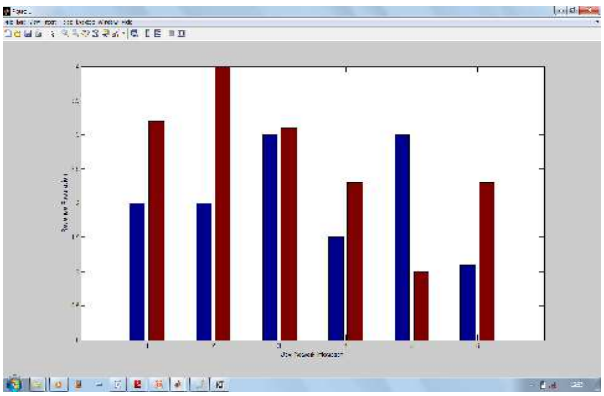

Figure 4. Energy Oriented User Where User Prefers Low Energy But The Cost And Energy Is High

Third Case: Third Case describes that it is of both quality and Energy oriented user where the user prefers equally for quality and energy over cost.(W_q=0.4,W_e=0.4,W_c=0.2) is shown in Figure. 5.

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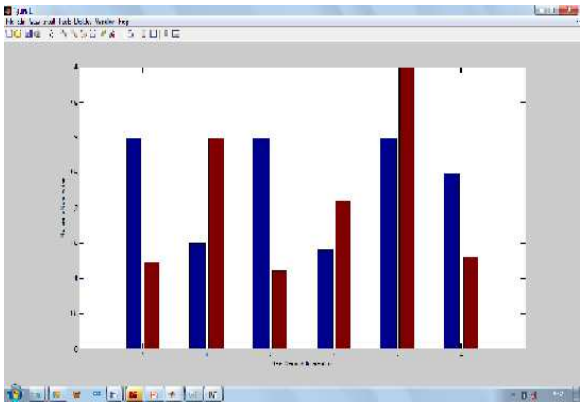

Figure 5 Energy And Quality Oriented User Over Cost .(W_q=0.4,W_e=0.4,W_c=0.2)

Two networks are being considered namely WLAN and WiMax. A median-based network selection is discussed in [6] considering different decision factors.Both networks are connected to IP Backbone Network. A Decision Maker connected to IP Backbone Network receives and updates user information and network information. A best network is selected by calculating the utility function and some defined parameters such as received signal strength, Bandwidth availability, User requirement etc. WLAN network is under the coverage area of Wimax. Certain Mobile nodes are being deployed and the best network which satisfies the user requirement ie (Multimedia applications) is connected to the mobile node. The Best network communicates with user. In Future after finding the best network, the network performance such as throughput, delay and jitter are being compared with conventional networks.

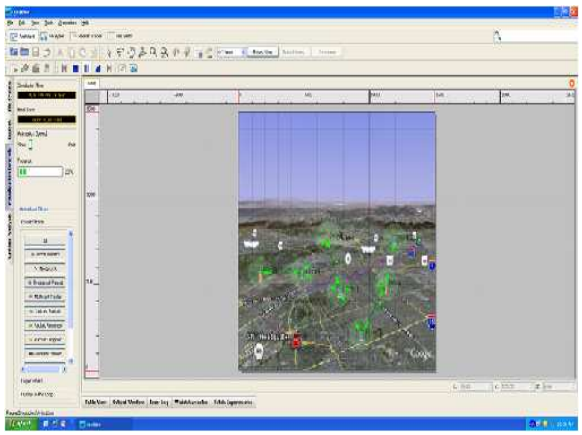

Figure 6 Selecting The Best Network

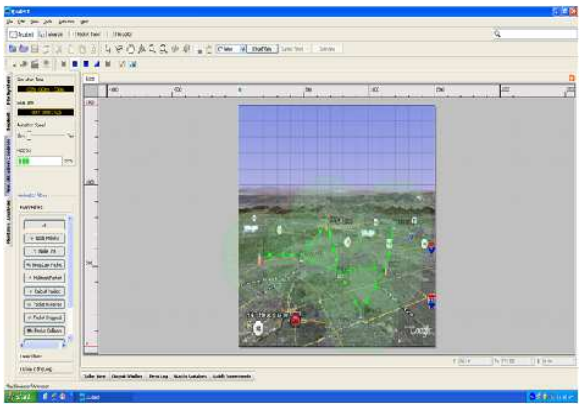

Figure.7 Selecting The Best Network And Communicating With The User

9. CONCLUSION

In this paper, we presented an auction game to select the best network on multimedia application by calculating the utility function like energy, quality and cost. An Auction game takes place to find the highest bidder .The Bidder who wins the game will be served with their requirement. The user requires multimedia applications like VoIP, Web Browsing, Data Transfer, Streaming.According to user application the network serves the user. Network Selection plays a major role in this paper. Best Network selection result is being presented. In Future the best network performance such as throughput, delay and jitter can be evaluated.

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