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A NOVEL RESOURCE ALLOCATION METHOD FOR MULTICASTING NETWORK USING GREED APPROACH

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ABSTRACT— WiMAX relay networks make resource allocation decisions once per frame. To achieve a performance gain possible under adaptive allocation. it is important to choose an appropriate practical algorithm feasible for real-time implementation. In this work, the allocation task is considered as a two-step process and several combinations of algorithms for each step are proposed. Performance of algorithms is evaluated on a WiMAX model with variable bit rate traffic. In our proposed method, we focus on multihop (relay based) bandwidth allocation schemes for IEEE 802.16j networks. This study reduces the well-known NP-hard problem called 0/1 knapsack problem to the network performance maximization problem, the key components in WiMAX, QOS guarantee are the admission control and the bandwidth allocation in BS. WiMAX standard defines adequate signaling schemes to support admission control and bandwidth allocation, but does not define the algorithms for them. This absence of definition allows more flexibility in the implementation of admission control and bandwidth allocation.

KEYWORDS— Greed approach, IEEE 802.16, IPTV multicast, WiMAX

I. INTRODUCTION

WiMAX is the end to end technology that provides low cost applications and last mile solution for broadband wireless accesses. This is based on the standard family defined by IEEE 802.16 which provides Coverage of up to 31 miles compared to other technologies; DSL can cover 3.6 miles; Wi-Fi can only cover 31 meters. WiMAX has unique characteristics which allow the base station to handle thousand of subscriber stations (SS, provides a collision- free MAC Uplink/downlink (UL/DL) channels, it also provides efficient handover procedure and Power control mechanism by introducing the sleep mode for mobile station (MS).It Supports the Data, Legacy voice system, VoIP, TCP/IP, Applications with different QoS classes, and different level of guarantees. The basic two layers in IEEE 802.16 are the MAC and the physical (PHY) layers. This PHY layer Combines OFDM/OFDMA Orthogonal Frequency Division Multiplexing/ Multiple Access and uses multiple input and multiple output antenna technology with an adaptive coding and Modulation schemes to support various bandwidth request demands issued by the MAC layers services. The MAC layer in turn provides a medium independent interface to the physical layer as the standard medium access functionality.

The mobile WiMAX supports mobility by Introducing a Mobile Stations (MS) instead of SS. MS in this standard can stay connected during movement from one BS coverage area to another BS coverage area through efficient handover procedures between Base stations. It uses Scalable OFDMA (SOFDMA) technology to enhance spectrum efficiency and reduce cost in wide and narrow band channels. It obtains the scalability by allowing different FFT point values for each channel width to resulting in a constant carrier spacing. It adapts to the Advance antenna technology supporting the Multiple In Multiple Out MIMO technology and uses hybrid automatic repeat-request (HARQ) to enhance reliability Turbo Coding and Low-Density Parity Check (LDPC) It uses the downlink sub-channelization, allowing administrators to trade coverage for capacity or vice versa.

II. UTILITY-BASED RESOURCE ALLOCATION FOR IPTV MULTICASTING

A. System Model and Problem Specification

In WiMAX relay networks, the downlink sub-frames are allocated in time. Let T is denoted by the total number of time slots allocated for IPTV multicast streaming service in a downlink sub frame. Assume that there are M subscribed video recorder programs denoted by $P=\{P_1,P_2,P_3\ldots.,P_M\}$ in the system, and each program can be encoded into at most L layers. We further assume that the set of disintegrate profiles each user can choose from is denoted by $B=\{B_1,B_2,B_3\ldots..,B_W\}$. Without loss of generality, we assume the toughness of the break open profiles in descending order, i.e., the toughness of B_i is $B_1 > B_2 > B_3\ldots B_W$. Therefore, the data rate associated with each outline is in ascending order, and the number of time slots captivated for sending the same amount of data is in descending order.

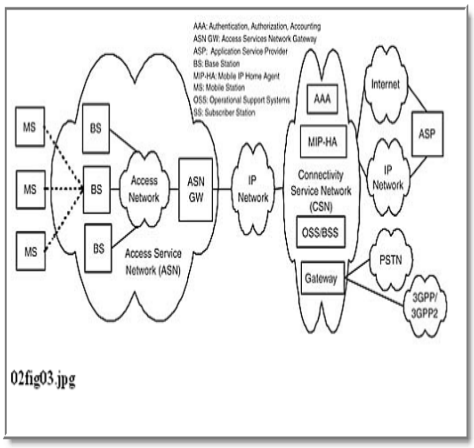


Fig. 1 System Model and Problem Specification

In this system, layer-encoded programs are supported, by each layer of a program of multicast sub session. The utility connected with a layer of each video program is defined as the supplementary delight for a user receiving this layer. The utility value can be measured by using the video quality professed by the user, which can be described by metrics such as the peak signal-to-noise ratio (PSNR).

There are two important property of the utility function for layer-encoded multicast stream. First, layer of video program m goes into effect for a user only when all the layers of program m lower than (i.e., layers 1,2,…..,i-1) have all been received by the user. Therefore, the utility function with respect to the number of layers being received by a user is a set of step function. Second, for a certain user, if it can receive up to layers of program, the channel conditions of user for receiving streams from all these sub sessions are identical. This is obvious as these sub streams of every single one come from the BS to the same user. Communication that the channel conditions of all users receiving a certain layer of a program may not be identical.

The architecture exploits either Point to Multipoint (PMP), Mesh, or Mobile Multihop Relay (MMR) mode. PMP architecture was introduced as the first standard of WiMAX in 2001. In this type of mode, a subscriber station connects to the base station in a single hop route. Mesh mode subscriber stations can interconnect in an ad-hoc fashion. Mesh mode gained too much attention by researchers but was not much deployed in the real world because it supports only OFDM version and is not compatible with PMP with completely different frame structure and network entry procedure. The mobile multi hop relay (MMR) mode in 802.16j was introduced as an extension for PMP mode in IEEE 802.16e.

MMR PMP but its achieving higher throughput and enhancing coverage. Unlike PMP mode, MMR Supports both OFDM and OFDMA operations and is backward compatible with a PMP mode. MMR differs from PMP by introducing the Relay Stations in which mobile station can use as intermediate route forwarders to the BS like a tree topology rather than a PMP or MESH topology. MMR consist of three network entities BS, relay station (RS) and mobile station (MS). RSs have the functionality of playing and intermediate forwarder to forward traffic between any MS and the BS.

B. Utility Envelope-Based Allocation for Layer-Encoded Multicasting (UE-LEM)

Mobile motion prediction algorithm predicts the "future" location of a mobile user according to the user's movement history, i.e., previous movement patterns. The task of motion prediction is to follow the motion of the mobile station in unusual gateways. Motion prediction is very useful as it vigorously locates the path of the mobile station in order to prevent handoff blocking problem

The Motion Prediction Algorithm (MPA) predicts the next state of movement or movement tracks by using connection analysis of current movement-itinerary with the MT/MCs in the IPB and with the associated analysis using the probability information. The output of the MP algorithm (P out or C out) is a future state or a sequence of future states. operation of the MPA includes means for comparing input states provided to the MPA with predicted states generated by the MPA and methods for matching input states to IPs (MTs/MCs) stored in the IPB and for generating predictions. If the comparator indicates that a prediction is right, i.e., then the current input state matches the predicted state, the rest of the predicted IP is provided as the output of the MPA. If the comparator indicates that the current input state does not match the prediction, or when the MPA is initialized, a motion prediction process is carried out to generate the next prediction. When an input state does not match the corresponding predicted state, the sequence of input states beginning with the most recent stationary state or boundary state is compared by the MP to each of the MCs and MTs stored in the IPB. This matching process determines the best-matched stored journey pattern, which becomes the output of the motion predictor, or selects the state with the highest probability to be the next state of the movement as the C out of the prediction by using stochastic and Markov process analysis. Three classes of matching schemes are used for correlation analysis of MCs or MTs. The first-class of matching (with a index), called state-matching, indicates the degree to which a sequence of states matches another sequence of states having a similar length:

$$\mu = \frac{m_s}{N_s} ,$$

Where ms is the number of states in the sequence that matched, and Ns is the total number of states in the sequence.

2) Resource Allocation Based on Utility Envelope Function:

There are so many improvements in the Internet including Quality of Service, network performance, and inexpensive technologies, such as DSL. But one of the most important advances has been in Virtual Private Networking (VPN) Internet Protocol security (IPSec). IPSec is one of the most complete, secure, and commercially available, standards-based protocols developed for transporting data. A VPN is a most important shared network where a private data is segmented from other traffic so that the intended recipient has access. The term VPN was originally used to describe a secure connection to the Internet. Today VPN is also used to describe private networks, Frame Relay, Asynchronous Transfer Mode (ATM), and Multiprotocol Label Switching (MPLS). A key aspect of data security is that the data flowing across the network was protected by encryption technologies. Private networks lack data security , which can allow data attackers to tap directly into the network and read the data. IPSec-based VPNs uses encryption to provide data security, which increases the network's resistance to data tampering or theft. IPSec-based VPNs can be created over any type of IP network, including the Internet, Frame Relay, ATM, and MPLS, but only the Internet is inexpensive

II. PERFORMANCE ANALYSIS

We must compare both the theoretical and simulation results under our protocol with those under the protocol in since the cooperative authentication protocol is of particular importance in the high-load scenario, we thus only focus on the highway scenario in this part. We assume six percent of the vehicles are malicious in our simulations. We also compare both the theoretical and simulation results under our protocol with those under the protocol .Since the cooperative authentication protocol is of particular importance in the high-load scenario, we thus only focus on the highway scenario in this part. This algorithm developed a -approximation algorithm called Bounded NIFF (BNIFF) for the 0/1 knapsack problem. BNIFF provides a tight bound of profit by executing NIFF twice. Because BNIFF can guarantee a performance bound in the worst case, this study uses the concept of BNIFF to modify GWA, i.e., Section 3.3.4 extends GWA to a bounded version BGWA. We formally prove that the proposed BGWA is a -approximation algorithm for the multicast bandwidth allocation problem as follows.

In this section, we prove that the utility maximization problem is NP-hard. We show that the proposed algorithm is sub-optimal, with a tight bound to the optimal solution. The SA contains all the information necessary for Gateway A to negotiate a secure and encrypted communication stream with Gateway B. This communication is often referred to as a "tunnel." Each gateway must negotiate its Security Association with another gateway using the parameters and processes established by IPSec. As illustrated below, the most common method of accomplishing this process is via the Internet Key Exchange (IKE) protocol which automates some of the negotiation procedures. Alternatively, you can configure your gateways using manual key exchange, which involves manually configuring each parameter on both gateways.

1) Load Balancing

Load balancing can be described as the process of dividing and distributing jobs among more than one server, accordingly more jobs can be served and the entire system can perform more competently. Load balancing has been frequently operated in computer systems for load sharing, but has also been used in telecommunications. Generally, load balancing can be done in a static or dynamic way. Static load balancing is independent of situation of the system is in dynamic load balancing, decisions are made regarding to the current loading status of the system and availability of resources. Load definition, load measurement and load balancing mechanism are the most essential elements in load balancing process. This follows, the definition of load, the process of load evaluation, and also loads balancing mechanisms in mobile WiMAX networks.

2) Resource allocation schemes

The scheme of load balancing of the system by using resource allocation is based on unused resources to the area where most of users are placed. In this approach, a centralized component assigns additional or free resources to overloaded cells. Resource allocation can be categorized into two main classes, fixed channel allocation (FCA) and dynamic channel allocation (DCA). In a Fixed Channel Allocation class, a fixed number of channels are allocated to each base station. Though, this scheme does not use the channel sufficiently because of the variability of the traffic. In the process of Dynamic Channel Allocation as an enhancement to the Fixed Channel allocation can adapt itself with changes in traffic and adjusts frequency assignments relevant to the traffic load. Most of the major researches in this type of domain have proposed channel borrowing algorithms (CBR) which states in the second category, dynamic channel allocation. The main principle of CB algorithms is using remained resources of cells with lower rate of traffic. Although Mobile WiMAX provides a flexible way to allocate frequency resources in DCA manner between BS, it won't be applied at least in the early stages of WiMAX deployment. However, FCA was preferred based on its simple mechanism.

3) Load Distribution Scheme

In order to balance the load of the system through the load distribution scheme the offered traffic should be directed to where more resources are available. The main way of operating load distribution is to use handover-based algorithms. Handover process would be conducted in two ways: MS and BS initiated handovers. The first method for load distribution is load balancing based MS initiated handover. In this process, the load balancing logic locates in MSs, hence MSs in the overloaded cells configures the load situation and chooses the least congested access points. This approach has been implemented in WLAN terminals and it can be also used in mobile WiMAX networks, based on the available resource information broadcasted in the MOB-NBR_ADV message. The second and the most significant load distribution method that should be considered is load distribution based BS initiated handover. In this scheme, the load balancing algorithm resides in BSs and the congested SBS forces the MS to handover to a less congested TBS. This method is suitable for mobile WiMAX, as it enables stronger control for BSs also providing better QoS in the whole network.

4) Handover

As the main way of load balancing is distributing load of the network with the handover process, over viewing handover process is necessary. One of the most important features of mobile WiMAX through mobility domain is handover. Handover means changing the serving BS by the MS if another BS is available to achieve higher throughput in the network. Furthermore, handovers are the essential component of system wide resource utilization and QoS. In IEEE 802.16e, handoff process may be initiated based on two reasons. The first one is caused by fading of the signal and interference level within the current cell or sector, while the second one is based on the fact that another cell or BS can offer a higher level of QoS for the MS, so MS will transfer to a neighbor cell or BS.

5) Congestion

The IEEE 802.16 standard, which defines a new mobile air interface specification for WiMAX access, is based on the IEEE 802.16estandard but extends it to support the mobile multihop relay (MMR) operation. The key purpose of a RS is to aid a good quality of communication between BS and the MSs which are out of the effective transmission range of BS. Such RS enabled mobile multi-hop relay transmission mode has been the focus of recently formed IEEE 802.16 task group.

A generic topology for an IEEE 802.16 WiMAX network is illustrated. Generally in IEEE 802.16 WiMAX networks all traffic sessions occur between BS and end user stations (MSs), the RS is to relay or forward each session passing by it. Although the multi-hop relay for coverage extension in wireless is an old concept, however its application on bandwidth management and traffic scheduling becomes practical only recently. As for the traffic transmission in such a multi-hop relay network, two design issues needs to be considered: one is the end to end flow control between the source stations and end receiver stations, so as to meet the diverse requirement of each receiver; the other is the congestion control in the middle of WiMAX network, so as to avoid the link jam or system performance degradation. . Moreover the link status (or quality) in wireless network may vary from time to time, which leads to a time varying link capacity. In this respect how to adapt to link status variation to enhance its efficiency is an important issue in both the flow and congestion control.

Research literature was occasionally proposed for tackling those above issues in IEEE 802.16 networks. This Provides an effective scheduler to achieve stable traffic transmission and high bandwidth efficiency over the whole IEEE 802.16 WiMAX network. Specifically the intermediate nodes of the RS will play a critical role in both the flow and congestion control over the whole network. The traffic transmission in an IEEE 802.16 WiMAX network can be either downlink transmission which is from BS to MSs or uplink transmission vice verse. Specifically the downlink channel in IEEE 802.16 this network is a broadcast physical channel to which all relevant MS stations can listen at the same time, hence the multicast transmission can be adopted in the downlink transmission.

III. PROPOSED SYSTERM

The proposed system considers a WiMAX relay network with a limited amount of bandwidth, and proposes an algorithm to maximize the target network performance (e.g., network throughput and number of satisfied users). Because the bandwidth is partial, not to all the SSs can be satisfied at the same time. In this case, it is necessary to determine which set of SSs to serve first and determine the corresponding serving priority to maximize network performance. Unfortunately, this type of problem is NP-hard (as Section 4.1 formally proves). This study reduces the well-known Nondeterministic Polynomial hard problem called 0/1 knapsack problem .

The **knapsack problem** or **rucksack problem** is a problem in combinatorial optimization: Given a set of items, each with a mass and a value, determine the number of each item to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible. It derives its name from the problem faced by someone who is constrained by a fixed-size knapsack and must fill it with the most valuable items, to the network performance maximization problem. To find the near optimal solutions of these NP-hard problems in polynomial time, we first develop a greedy weighted algorithm. This GWA that determines the set of SSs and serving priority leading to the suboptimal network performance. Which defines the weighted value Wm; n of each SSm; n as the performance gain per bandwidth unit. Following the decreasing order of Wm; n, GWA sequentially examines the SSs for bandwidth allocation. Note that, if more than one SS has the same Wm; n value, the SSs' bandwidth requests can be handled in a random order. To guarantee that the worst case performance is lower bounded, we enhance the proposed GWA to be a bounded greedy weighted algorithm, called BGWA.

IV. Simulations Results

A. Simulation Settings

In this section, we evaluate the performance of our designed mechanism *UE-LEM* using simulations. The network parameters follow those values précised in the WiMAX standards. The set of data rates for burst profiles is determined in accordance with the modulation schemes defined in the WiMAX standards and then normalized by the maximum data rate of the set. We assume that only one-fourth of the timeslots in each frame is used for IPTV multicast. The remaining timeslots may either be used for the uplink transmission or for downlink unicast service. The total number of users in an antenna sector is set to 255. We consider two settings A and B of user distribution with respect to their channel conditions so that we can study the impact of the users' means quality on the system's allocation. With Setting A, the number of user under each type of channel quality is the same; with Setting B, the better channel quality is more than the quantity of users, and hence many users are in the best channel condition. We reproduce two three-layer video programs, Programs I and II, with the total bandwidth requirement of each program fixed at 500 kbps and with a total utility of 1.1.

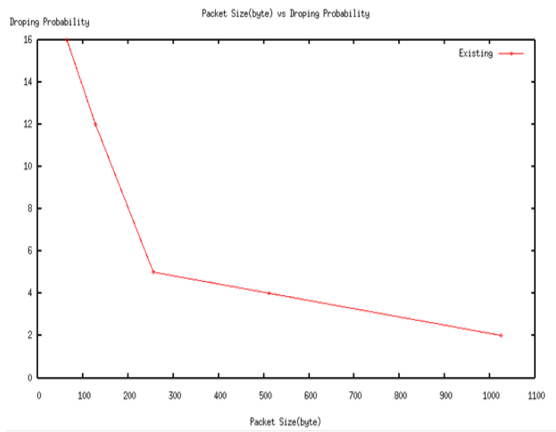


Fig. 2 Packet size (byte) Vs Droping Probability

B. Simulation- I

In simulation 1, we compare two approach which use a layer-encoded program and a single-layer program, this is over a WiMAX network. The organization multicasts Program I and a single-layer program to 255 users which are situated in the same antenna sector and whose channel circumstance settings follow Setting A. To monitor the significance of the layering approach on the system performance, the facts rate of the single-layer program is fixed at 505 kbps, and the total utility is 2, which are equal to the total utility and the summative data rate of Program I's three layers.

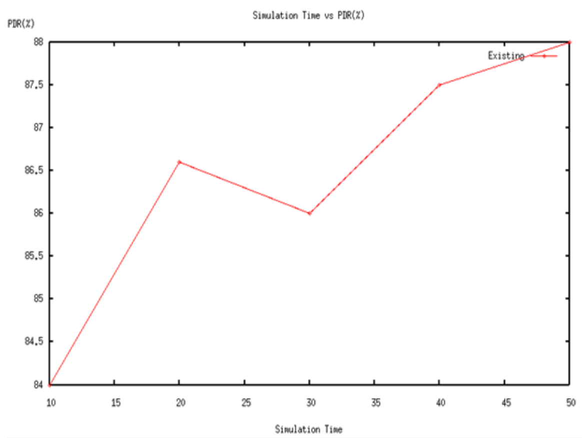
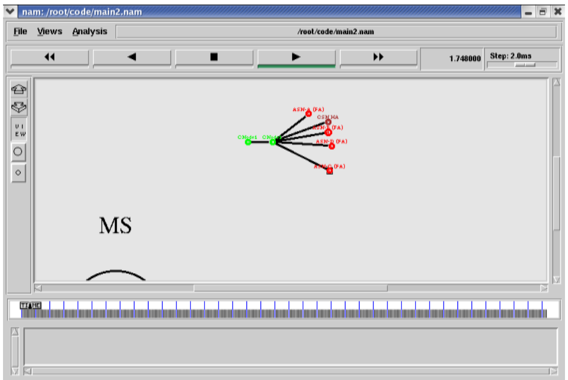


Fig. 3 Simulation Time vs. PDR(x)



C. Simulation II

In the simulation 2, the total number of users is fixed at 255 and the channel situation allocation for the users also follows Setting A. We tune the ratio between the numbers of Program I and Program II subscriber to observe the behaviour of the system. The items “[a,b]” in the -axes denote the percentages of users subscribing to programs [a,b] over all 255 users in the system.

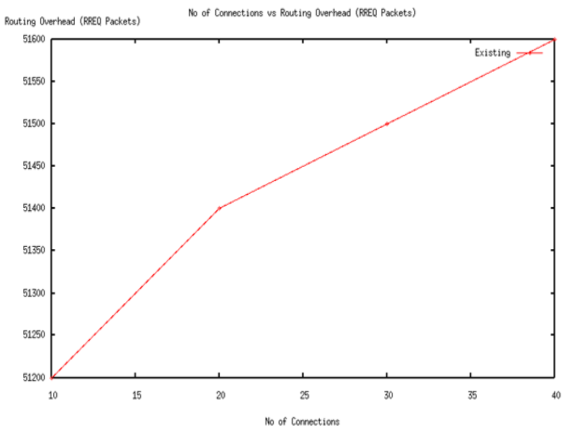
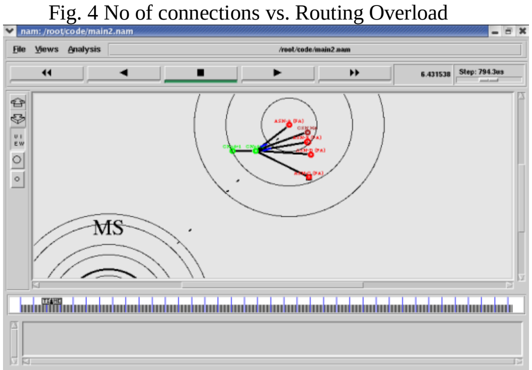
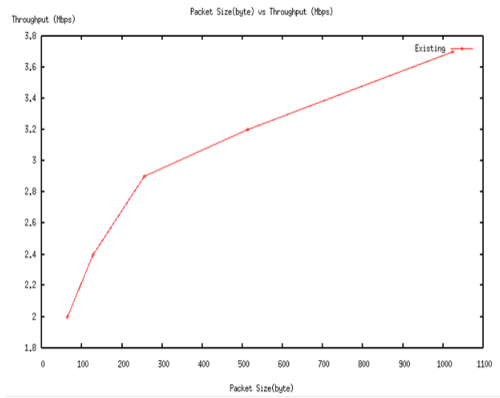


Fig. 4 No of connections vs. Routing Overload



C. Simulation III

In the type of simulation 3, we observe the performance of resource allocation to each layer of users by *UE-LEM*. When the total resource devoted is around 71%, all users can receive all layers requested. We should find the resource allocation using Setting A tends to allocate layer-1 stream to all users in lower layers before higher layers are allocated. This is because with Setting A, each burst profile is used by the same number of users and the average utility of lower layers is higher, so that allocating lower layers can achieve a very higher total utility. On the other way, with Setting B, the system tends to favour users with much better channel qualities and serve them more. This is because with Setting B, there are more users in the better channel conditions, and therefore, the system can achieve a higher utility by allocating users with better channel qualities.



V. Conclusion

In this paper, we conclude and we have proposed a utility-based resource allocation scheme, called *UE-LEM*, for layer-encoded multicast streaming service in WiMAX networks. This scheme can run in polynomial time and the difference of its routine and the best possible resolution is within a small value. Thus the performance of the future scheme is evaluated by simulation. We show that under the same conditions, layer-encoded programs have higher total utility than single-layer programs, making the former more opposite in WiMAX environment. We also show that the system can tune the due resource to users according to the number of subscribers and the utility meaning of each program.

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