

IMPROVED QOS AND EFFICIENT RESOURCE ALLOCATION FOR MOBILE LOAD BALANCING IN WIMAX NETWORK AND MANET

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The idea behind balancing the system load with resource allocation is to bring the resources (unoccupied frequencies) to where most of the users are located. In resource allocation schemes, a centralized element allocates additional resources to hotspot cells. One example of this is channel borrowing where a congested Base Station can borrow the channel of lightly loaded Base Stations. Channel borrowing requires that the system supports Dynamic Channel Allocation (DCA), which is an enhancement to the traditional Fixed Channel Allocation (FCA). DCA is able to adjust to changing traffic whereas FCA will keep the same frequency assignments irrelevant of the traffic load. Although Mobile WiMAX as well as Mobile Ad Hoc Network provides a flexible way to allocate frequency resources making DCA between BSs possible, DCA won't be used at least in the early stages of deployment. FCA will be applied for the frequency sets resulting from Partial Usage of Sub-Channels (PUSC) sectorization.

Key words: MANET, WiMAX, Flocking, Load balancing, Wireless Sensor Network, Fixed Channel Allocation, Dynamic Channel Assignment, channel borrowing scheme.

1. INTRODUCTION

A MANET is an autonomous collection of distributed mobile users. Every host in a MANET works as a source and a sink, and also relays packets for other hosts and is thus a router as well. This type of network can be used in fire/safety/rescue/disaster recovery operations, conference and campus settings, car networks, personal networking, etc. MANETs have similar characteristics to other wireless communication networks, which are mainly attributed to the wireless channel's properties (Y. Zhou, F. Ding, and A. Song) [6].

A wireless channel is error-prone, which means that link bandwidth and packet delay are

unpredictable due to multi-path fading, interference, and shadowing. Besides this common characteristic, MANETs have their own features: That are autonomous and infrastructure less; they utilize multi-hop routing; they support a dynamic network topology; the nodes are energy constrained; the bandwidth is limited; and that are self-organizing and self administering. Therefore, many widely used network protocols cannot directly be applied to MANETs (R. Shorey, ed. John Wiley & Sons) [5].

In order to support Quality of Service (QoS) in MANETs, the network is expected to guarantee a set of measurable metrics, such as delay, delay variance (jitter), bandwidth, packet delivery rate, etc. The hidden node problem, the need to share channel resources, the distributed organization of the network and the dynamic topology of MANETs bring challenges to offering QoS.

2. RELATED WORK

The mobile sensors dynamically adjust their positions according to the target's motions. Importance to design a dynamic moving strategy based on the measurements to improve the tracking quality. It is worth noting that the mobility of the sensors tremendously enhances the performance of the tracking system, but it also brings in certain design challenges. To choose a minimum set of mobile sensors to move and assigned destinations of each selected sensor.

To transform the problem into coverage problem with mobile sensor networks by utilizing the moving model of target. Since the model itself contains uncertainty, we will focus on the guaranteed capture with minimal number of moving sensors at each step. Due to the highly constrained energy in MSN, further design the moving destinations of sensors at each step so that the total traveled distance would also be minimized.

(J. Teng, H. Snoussi, and C. Richard) [9] as technology advancements in robotics and wireless communication, tracking mobile targets using mobile sensors used widespread concern in recent years. A novel is proposed to coordinative moving strategy for autonomous mobile sensor networks to guarantee the target can be detected in each observed step while minimizing the amount of moving sensors.

A wireless sensor network (WSN) consists of spatially distributed sensors connected via a wireless link. Sensors may be designed for pressure, temperature, sound, vibration, motion. Consider the problem of target tracking in a WSN. It is especially challenging in presence of measurements which are outliers. Two algorithms for target tracking robust to outliers are proposed.

Assume that only the maximum number of outliers is known. Based on interval analysis, these algorithms perform a set-membership estimation using either SIVIA or a combinatorial technique. In both cases, sets of boxes guaranteed to contain the actual target location are provided.

A novel approach for single target tracking robust to outliers is inspired by (Leger and Kieffer) [15], the approach assumes that the maximal number of outliers is known. According to this approach, the estimation problem is defined using connectivity measurements performed between the target and the sensors of the network. Two algorithms are then proposed to solve the tracking problem. Based on interval analysis, they both perform a set-membership estimation using either the SIVIA algorithm (Set Inversion Via Interval Analysis) or a combinatorial technique. The estimated positions with both methods are sets of boxes, guaranteed to contain the actual target locations.

The challenges within data mining research areas like discovering a list of classification rules, clustering, processing large amount of data and eliminate redundant information, etc need to be resolved in an intelligent manner. Feature selection and feature extraction are the two important processes in a classification system. High quality and fast clustering algorithms play a vital role for users to navigate, effectively organize and summarize data.

(Gianni A. Di Caro, Frederick Ducatelle) [17] Ant Colony Optimization (ACO) is a technique is inspired by the foraging behavior of ant colonies. ACO algorithms have long been thought as generating high quality solutions for various problems in different Engineering Applications.

Overview of past and on-going research of ACO in diverse engineering applications pertaining to computer science fields such as mobile and wireless networks, sensor networks, grid computing, P2P Computing, Pervasive computing, Data mining, Software engineering, Database systems, Multicore Processing, Artificial intelligence, Image processing, Biomedical applications and also other domains relevant to Electronics.

3. PROPOSED METHODS

3.1 Algorithm Used

3.1.1 Geographic Adaptive Fidelity (GAF)

Geographic Adaptive Fidelity or GAF (Y. Xu, J. Heidemann, D. Estrin) [16] is an energy aware location-based routing algorithm designed primarily for mobile ad hoc networks, it is used in sensor networks. GAF aims at optimizing the performance of wireless sensor networks by identifying equivalent nodes with respect to forwarding packets.

In GAF protocol, each node uses location information based on Global Positioning System (GPS) to associate itself with a “virtual grid” so that the entire area is divided into several square grids, and the node with the highest residual energy within each grid becomes the master of the grid. Two nodes are considered to be equivalent when they maintain the same set of neighbor nodes and so they can belong to the same communication routes.

Source and destination in the application are excluded from this characterization. Nodes use their GPS-indicated location to associate itself with a point in the virtual grid. Inside each zone, nodes collaborate with each other to play different roles.

Nodes will elect one sensor node to stay awake for a certain period of time and then they go to sleep. This node is responsible for monitoring and reporting data to the sink on behalf of the nodes in the zone and is known as the master node. Other nodes in the same grid can be regarded as redundant with respect to forwarding packets, and thus they can be safely put to sleep without sacrificing the “routing fidelity” (or routing efficiency).

Algorithm For Geographic Adaptive Fidelity (GAF)

$C \leftarrow \text{setofcoordinatornodes}$

```

while network is not partitioned do
while C =  $\emptyset$  or sink node not reached do
Pick a node randomly from C
GEAR()
end while
Send information from the sink to the source node
Elect new coordinator nodes, C''
C  $\leftarrow$  C''
end while

```

3.1.2 Geographic Energy Aware Routing (GEAR)

Geographic and Energy Aware Routing (GEAR) technique uses energy aware and geographically informed neighbor selection heuristics to route a packet towards the target region. Within a region, it uses a recursive geographic forwarding technique to disseminate the packet.

Although the energy balancing design of GEAR is motivated by sensor net applications, our protocol is generally applicable to ad-hoc networks. To simulate GEAR for uniform and non-uniform traffic distributions, and compared its performance to GPSR, which is a non energy-aware geographic routing algorithm. For non-uniform traffic, GEAR delivers 70% to 80% more packets than GPSR. For uniform traffic, GEAR successfully delivers between 25% and 35% more packets than GPSR.

GEAR performs significantly better in terms of connectivity after partition the fraction of pairs remaining connected after a "partition" (when all sources are partitioned from their respective target regions). To implementing a prototype of GEAR protocol in a moderate size test bed.

Algorithm for Geographic Energy Aware Routing (GEAR)

```

if Node receives packet for the first time then
Mark Node as received
Parent  $\leftarrow$  Sourceof packet
Source  $\leftarrow$  Node
Increment Level Field

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Rebroadcast packet
end if

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3.1.3 Advantage of Using GAF and GEAR

Analyze the end-to-end robustness of the protocol to data-packet loss, energy consumption and error rate. The analysis results are used to compare with two non-co operative schemes such as disjoint path, one path and cooperative scheme such as GAP protocol.

3.1.4 Justification of Using GAF and GEAR

Geographic Adaptive Fidelity can conserve more energy than directed diffusion, Each node keeps an estimated cost and a learning cost of reaching the destination through its neighbors. The estimated cost is a combination of residual energy and distance to destination. The learned cost is a refinement of the estimated cost that accounts for routing around holes in network.

3.2 Resource allocation schemes

3.2.1 Channel Borrowing

The idea behind balancing the system load with resource allocation is to bring the resources (unoccupied frequencies) to where most of the users are located. In resource allocation schemes, a centralized element allocates additional resources to hotspot cells.

DCA is able to adjust to changing traffic whereas FCA will keep the same frequency assignments irrelevant of the traffic load. Mobile WiMAX as well as Mobile Ad Hoc Network provides a flexible way to allocate frequency resources making DCA between BSs possible, DCA won't be used at least in the early stages of deployment. FCA will be applied for the frequency sets resulting from PUSC sector.

3.2.1.1 Technique Used :(Partial Usage of Sub-Channels) PUSC sectorization

WiMAX in IEEE standard is defined as IEEE 802.16, which is also named as broadband wireless access (BWA). Two kinds of topology are currently problematic are, the **PMP(Point-to-multipoint) topology and the mesh topology**. It is just like the difference between infrastructure mode and Ad hoc mode in WLAN. In IEEE 802.16 the transmission, It

can do a great help to network users especially when they are in outdoors if these problems are rectified.

3.2.2 Quadra Threshold Call Admission Control Protocol

In our threshold-based bandwidth sharing scheme, each connection type is assigned a bandwidth threshold value according to a priority given to each connection type. The order of threshold priority is given as: UGS > ertPS > rtPS > nrtPS. BE connections are not considered.

In 802.16 MAC layer, the Best Effort (BE) connections get the transmission opportunities only when other service connections do not transmit. Generally, BE connections do have long idle period and data in each transmission is relatively small, especially in the uplink direction. Therefore QoS of BE can be easily satisfied Let T denote the set of threshold values for connection types.

$$T = \{t_n, t_r, t_e, t_u\};$$

$$t_n < t_r < t_e < t_u < B$$

The parameters, t_n , t_r , t_e , t_u denote the threshold values for UGS, ertPS, rtPS, nrtPS connections and parameter B (Band Width), the uplink bandwidth capacity of the network respectively. The parameter B is dynamically adjusted by Base Station according to the uplink bandwidth requirement of connections after a period of time, T which is long enough for BS to understand the behavior of uplink bandwidth requirement.

3.2.3 Rate-Switching Mechanism

To implement a rate-switching mechanism inspired by the Hybrid Auto-Rate Fallback (HARF) scheme proposed in to adapt the transmission rate based on the channel's condition. The scheme inherits HARF's main mechanisms. These include first that the transmission rate is increased if a given number of ACK (Acknowledgement) frames acknowledging data frames are successfully received in a row. By contrast, the rate is decreased if a given number of ACK timeouts occur in a row (ACK misses).

The rate is not only increased or decreased by one level, but the Received Signal Strength Indicator (RSSI) corresponding to the last received packet is used to determine whether to keep increasing or decreasing the rate.

In that scheme, as opposed to HARF, the last received packet's power is compared to the receive

thresholds stipulated for the various rates. In the case of rate increase, the rate continues to be increased while the received power is higher than the threshold to be exceeded for switching to the next highest rate. A similar scheme is used for decreasing the rate, until it has been reduced to a value that has a lower receive threshold than the last received packet's signal strength.

4. RESULTS AND DISCUSSION

The primary focus is to improve the quality of service by rejecting less connection during admission. Several modifications have been added to the WiMAX model in order to implement the proposed uplink scheduler and call admission control. The simulations are programmed on the Mat lab platform, using some the analytical result. Simulation shows effect on network productivity in terms of acceptance ratio, bandwidth usage.

Result show the throughput for rtPS connection for MDRR is lower than CDRR, due to consideration of deadline request shows the bandwidth utilization ratio of existing and proposed call admission control algorithms with increase in the arrival rate. All connections soliciting for admission are rtPS connections, 86% of the total bandwidth units are used by that type of connection alone. Thus connection acceptance will be more in proposed model than the existing model as it use only the partitioned set of bandwidth which will be less than 86% total band width .

The nrtPS-PS connections suffer the highest blocking probability when compared to other connection types in the same scheme despite the high bandwidth value allocated to its partition. With proposed nrtPS-QT scheme, connections of nrtPS are admitted until the threshold value of 80 after when all nrtPS connections are rejected and if all the connections present are nrtPS connections 80% of the total uplink bandwidth are used. The blocking probability of nrtPS of PS scheme high compared the QT scheme.

5. CONCLUSION

Load balancing with directed handovers can be a very efficient way to enhance system wide Resource Utilization and also enhance the possibility to fulfill QoS guarantees in Mobile WiMAX. Network Architecture in terms of load balancing and handovers was conducted to exhibit the good

framework that Mobile WiMAX offers to conduct load balancing between neighboring Base Stations.

Based on the gained knowledge a basic Resource Utilization based load balancing algorithm tailored for Mobile WiMAX was designed and three enhancement proposals were made. The first defined a framework to automatically tune the load balancing triggering threshold and the second a framework to enable BS controlled load balancing for Best Effort Mobile Stations.

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