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A QoS-Oriented Data Transmission Technique for Hybrid Wireless Networks

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Abstract—

Wireless communication has grown into a vital technology in our day to day life. This has led to increased research undertakings which primarily focus on supporting real-time transmission with strict QoS requirements for wireless applications. A hybrid wireless network is a combination of wireless infrastructure networks and mobile wireless ad-hoc network (MANETs). Achieving QoS support in these networks is an open challenge as there are very less number of protocols that are exclusively developed for Hybrid Wireless Networks. In our paper, a new variant of routing protocol is proposed which gives better results improving the QoS with respect to a set of QoS parameters and under different constraints developed only for Hybrid Wireless Network. Mainly, it takes the limited resources of mobile environments (bandwidth, network size etc.) into consideration for achieving QoS. It incorporates the following algorithms: 1) Neighbour identification and path identification for data transfer to ensure QoS support, 2) Packet scheduling amongst the selected neighbour nodes to reduce the transmission time to a more extent. The above algorithms are designed in such a way that they reduce the data transmission delay, thus enhancing QoS support in Hybrid Wireless Networks leading to better performance.

Keywords— QoS; routing; mobility; bandwidth; delay

I. Introduction

Wireless applications are widely used in areas of commerce, emergency services, Military services, entertainment and so on. These are majorly used in areas where the infrastructure cannot be maintained and handled for a long time. Video streaming, online gaming, Online TV, video conferencing etc. are the most widely used applications all over the world through wireless mobile users. These applications use an infrastructure to directly connect mobile users for video watching or interaction in real time. There is an extensive usage of wireless and mobile devices and also the demand for mobile multimedia [1] streaming services are leading to a promising near future where wireless multimedia services (e.g., mobile gaming, online TV, and online conferences) are widely deployed.

The QoS support must ponder a number of Ad-hoc networks limitations (mobility, energy, scale, etc.). QoS can be hosted at different layers of the network (MAC layer, routing protocols at network layer, etc.). Routing operation comprises of discovery of the routes among communicating entities (transmitter / receiver)that are able to convey data packets uninterruptedly using less bandwidth and fewer packets control. QoS routing can be defined as the exploration for routes satisfying the desired QoS. To be eligible routes, they must satisfy a number of constraints such as delay, bandwidth, reliability, etc. [2]

In this paper we put forward a data transmission technique for hybrid wireless networks that stimulate the QoS support to a great level. Usually, a hybrid network has widespread base stations. The data transmission in hybrid networks has two features [my paper]:1) an access point can be a source or a destination to any mobile node. 2) The number of transmission hops between a mobile node and an AP is minor.

First feature permits a stream to have anycast transmission along numerous transmission paths to its destination through base stations, and the second feature allows a source node to link to an AP through an intermediary node. With these 2 features, QoS-oriented data transmission technique converts the packet routing problem into a dynamic resource scheduling problem. Precisely, if a source node is not within the transmission range of the AP, a source node chooses nearby neighbours that can deliver QoS services to forward its packets to base stations in a dispersed manner. The parameters that we consider for calculating the best path which has the neighbouring intermediary nodes, from source to destination, that which support QoS are bandwidth of an intermediary node, distance from source to destination, external factors like noise and interference and finally the hop count. The source node schedules the packet amongst the chosen neighbours depending on their bandwidth, delay that is faced due to external factors like noise and interference and mobility of nodes, aiming to decrease transmission time and enhance network capacity. These parameters are explained in the coming sections.

II. Related work

QoS is characterized with certain number of factors like throughput, latency, jitter and loss, etc. and can be defined as the degree of user satisfaction. QoS model architecture is intended to offer the best possible service. It must handle all the restraints and challenges enforced by Ad-hoc networks, like frequent topological changes due to node mobility, restrictions of reliability and energy consumption, so it defines a set of services that permit users to select a number of safeguards (guarantees) that administer properties such as time, reliability, etc. [4].

Standard models like Intserv / RSVP [5] and DiffServ [6] suggested in first wired network types are not appropriate for MANETs which necessitates negotiation of node, admission control, resource reservation, and packets priority scheduling [7]. However it is more stimulating to assure QoS in MANETs due to exceptional features like user mobility, channel variance errors, and limited bandwidth. As a result, efforts to directly take in the QoS solutions for infrastructure networks to MANETs mostly do not have great accomplishment [8]. Several reservation-based QoS routing protocols have been offered for MANETs [9], [10], [11], [12] which constructs routes formed by nodes and links that reserve their resources to fulfil QoS requirements. One of them being AODV (Adhoc On-demand Distance Vector) routing protocol, which is a dynamic resource reservation and reactive routing protocol [3]. The disadvantages of AODV are more noteworthy that include higher processing demand, consumes extra part of bandwidth, and takes more time to build the routing table which increases the overall delay and performance. This is undesirable in any of the networking applications. Also invalid reservation problem adds on to the disadvantages since the reserved resources become unused in case of breakage of the established path. Even though these protocols try to increase QoS of MANETs to a certain point, they suffer from invalid reservation and race condition problems [7]. In Invalid reservation problem if the data transmission path between a source and destination nodes breaks the reserved resources turn out to be useless. Race condition problem refers to a dual allocation of the same resource but on to two different QoS paths.

QOD-QoS-oriented distributed routing protocol [13] for hybrid wireless networks is a protocol that is exclusively developed for hybrid wireless networks. It incorporates the mentioned algorithms to achieve QoS: 1) a QoS-guaranteed neighbour selection algorithm to meet the transmission delay requirement, 2) a distributed packet scheduling algorithm to further reduce transmission delay, 3) a mobility-based segment resizing algorithm that adaptively adjusts segment size according to node mobility in order to reduce transmission time. It addresses the problem of race condition and invalid reservation problems. In this paper we propose a variant to QOD and is discussed in the below sections.

III. QOS-ORIENTED DATA TRANSMISSION TECHNIQUE FOR HYBRID WIRELESS NETWORKS

A. Overview

Hybrid Wireless Networks are characterized with high mobility and unstable bandwidth because of which guaranteeing and ensuring of QoS is always a challenge. Taking these considerations into account, we put forward a QoS oriented data transmission technique that makes certain QoS support in Hybrid wireless networks. In our technique, if a source node is not within the transmission range of an AP, it elects a neighbour based on their bandwidth, distance from source to destination, delay due to external factors like noise and interference and hop count to forward the data packets. The selection of neighbours aims at decreasing the data transmission time and increase network capacity. These intermediary neighbours then forward the packets to destination. The multiple paths identified help in transferring data at a faster rate. Here we propose 2 chief algorithms for ensuring QoS during data transmission:

1. Neighbour identification and best multiple paths selection for data transfer ensuring QoS,
2. Packet scheduling algorithm amongst the selected neighbouring nodes to further lessen the transmission time.

B. Neighbour identification and best multiple paths selection for data transfer ensuring QoS,

Data transmission is always associated with a small delay which is one of the foremost real-time characteristics. A delay of tolerable degree is acceptable, but if in case it exceeds to a great extent then we need to tackle the same. In this module for a specified source to destination, the neighbour nodes are selected using the Euclidean distance concept. The nodes are said to be neighbours of a particular node if it is within the specified threshold which in our case is 250m. aor all the nodes in the predefined topology the neighbours are calculated that fall within the threshold. The process of neighbour identification is done to all the nodes in a network. When all the neighbouring nodes are calculated, potential nodes are identified, which would form a best path in the direction of destination satisfying the QoS requirement. For computing potential neighbouring nodes some of the factors or parameters are taken into account. They are 1) Bandwidth of neighbouring nodes, 2) distance from source to destination 3) External factors that could be noise, interference, 4) Number of hops between source and destination.

Let us now, discuss these factors in detail which plays a major role in our neighbour node selection process. The first factor is bandwidth.

1) Bandwidth: Bandwidth of a node is a significant factor in our neighbour identification process. Each and every node is assigned with a bandwidth. Each node has a different bandwidth. In our technique, for a node to become a potential neighbour, its bandwidth is inspected and if it is able to transmit the data, then it is nominated as the potential neighbouring node. The basis of selection is that the bandwidth of a node must be at least the size of the biggest packet in the data transmission stream along the path towards the destination. This process of potential neighbour selection is carried on for every neighbour node that finally gives the best paths that is QoS guaranteed.

Although, numerous potential paths are available, the best potential paths guaranteeing QoS are identified for data transmission. The paths recognized in this process also consider others factors into account. Henceforth, while computing the paths, based on the parameters that we have considered and the packet arrival time there could be single path or multiple paths which are explained in the coming sections.

Next parameter that plays a major role is the “delay” which is due to some of the external factors like noise or interference.

2) External factors: external factors like noise, interference disturb the data transmission to a great magnitude. For example, in a video conference application; if there is too much of noise then it does not deliver the best quality of service to end users. The entire video conference session is delayed leading to poor application performance.

Consequently the delay due to these factors will increase and adds on to the total delay. In our simulation we have assigned a random value for these factors each time when delay factor need to added to total delay. We need to consider the least value for these factors among all the identified paths from source to destination. This value would be an allowable level of noise or interference value. The external factors could be due to number of nodes that are transmitting data at the same time that fall within the same transmission range or interference due to structures, constructions or any other objects on the way of data transmission. A best path is elected based on the small external value from among the potential paths towards destination. This promises QoS which reduces the total delay for data transmission.
Next parameter that is considered for calculating QoS oriented path is distance.

3) Distance: When all the paths from source to destination is calculated the paths with least distance towards destination is calculated that which satisfies high bandwidth, low noise and interference value is taken into account. The distance from source to destination is calculated using Euclidean distance.
The last factor is the hop count between source and destination

4) Hop count: as discussed previously, there is more than one path that is calculated towards the destination. The paths identified have a different hop count. In our process of data transfer a path with less hop count and those that do not share the same node to a possible extent is identified and the data is transferred in these paths if all the packets arrive at the same time or at different intervals. The path with the hop count consideration also considers all the above factors into account.
The final section explains how the packets are scheduled amongst the recognized best paths.

C. Packet scheduling amongst the selected neighbour nodes to further reduce the stream transmission time.
The first algorithm discussed above deals with the identification of neighbour nodes and best path selection that guarantees QoS provision for data transmission. To reduce the stream transmission time, packet scheduling algorithm is proposed for handling the packet routing. There could be more than 1 path in the direction of the destination. But the best paths are the ones that consider all our parameter promising QoS. A best path is one that has nodes with high bandwidth and that does not share the same hop to a possible level. In a multi path routing, data is split amongst the calculated multiple paths. The data that needs to be transmitted is split amongst all the available paths. This multipath data transfer assures faster data transmission.
The advantages of our technique are as discussed below:
Most of the works [14] concentrate on increasing the network capacity and routing reliability but does not assure QoS guaranteed services sharing limited bandwidth. If we directly adopt reservation based routing protocols developed for MANETs into Hybrid networks, then it leads to race condition and invalid reservation problems. Our technique concentrates on assuring QoS oriented data transmission by selecting multiple paths that can best deliver the packets with very less delay. The factors that we discussed earlier help in achieve the same. Since we select multiple paths the data transfer process is quick. Also the problems of race condition is solved since we are allocating the resources dynamically but not reserved beforehand. The problem of invalid reservation is also overcome by allocating the resources on demand that is when the paths are formed and only to the potential paths.

IV. IMPLEMENTATION
We have implemented our technique for wireless network using NS2 simulator. The topology used is as shown below wherein the figure 1 shows topology before mobility and figure 2 shows topology after applying mobility. Initially all the neighbour nodes are identified for all the nodes in a network using Euclidean distance. Next as discussed in the previous sections the paths are calculated that assures QoS support. The data that needs to be sent is split amongst the available paths and finally reaches the destination. Suppose we need to send data from source 0 to destination 15, the paths that are calculated are before applying mobility are "0 2 10 7 6 1 5 15" and "0 4 12 13 14 15 "and the paths after mobility are " 0 12 5 13 14 15" , "0 12 13 5 14 15" and "0 4 5 14 15". The scheduling module will schedule the data by splitting the data among these paths.

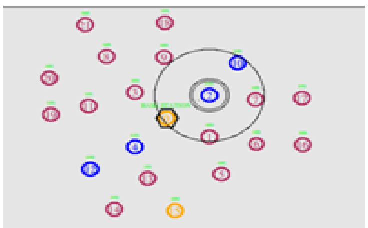

Fig 1 Topology before mobility

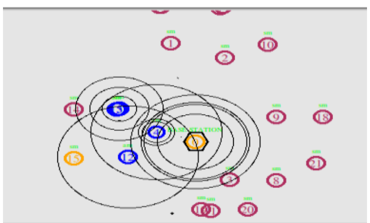

Fig 2 Topology after mobility

V. RESULTS

We have used Network Simulator for simulation of our technique. The simulation results are explained in the next sub sections.

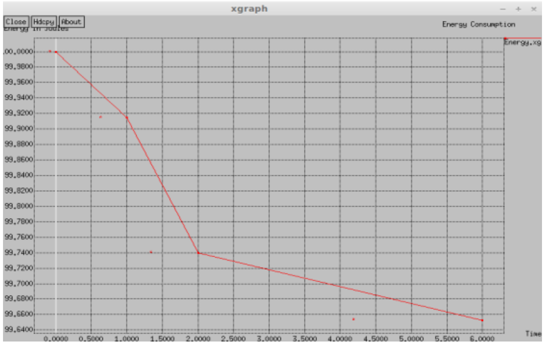

Fig 3 Energy Consumption

Initially all the nodes will be given some amount of energy in order to make the transaction. As the transaction takes place the energy consumption reduces which is desirable effect and is depicted in figure 3.

Packet loss happens when one or more packets of data transferring across a network fail to reach destination. Packet loss can be caused by a number of factors including signal degradation over the network medium due to multi-path fading, packet drop because of channel congestion. In our technique the packets which are sent are completely delivered to destination and is depicted in figure 4 Packet Drop.

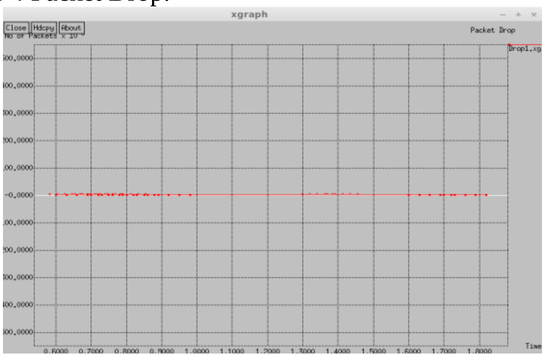

Fig 4 Packet Drop

Next metric that we discuss is the Packet Delivery Ratio (PDR). PDR is ratio of packet delivered to packet sent. The greater the value of ratio means the better performance of the protocol and here we can see that it is always 1 and hence the packets are completely delivered. This is illustrated in figure 5 packet drop ratio.

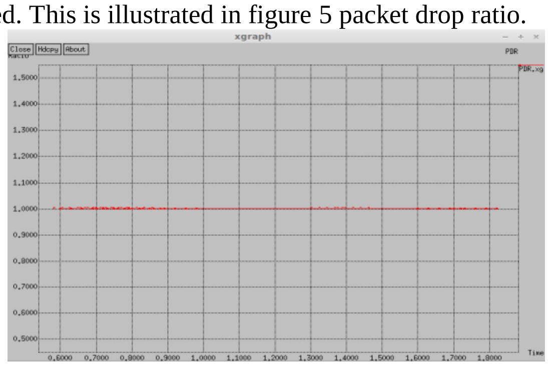

Fig 5 Packet Delivery Ratio

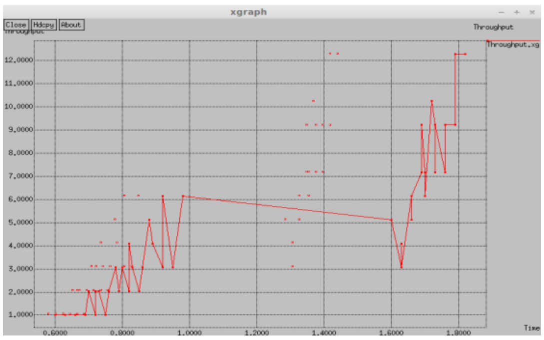

Fig 6 Throughput

The above graph in figure 5 shows the throughput of our technique. It is gradually increasing indicating good sign of data delivery

VI. CONCLUSIONS

QoS oriented data transmission technique is a work that is devoted to enhance the QoS requirement wholly for Hybrid wireless networks. HWN is an integration of MANETs and infrastructure network. Even though there are numerous routing protocols intended for MANETs or infrastructure network individually, they cannot be implemented directly into Hybrid Wireless Network because of the problems discussed above. The 2 main features of hybrid wireless networks that is, anycast transmission and short transmission hops transform the packet routing problem to packet scheduling problem. The 2 algorithms that we have implemented make data transmission by satisfying the QoS requirement to a great extent. The race condition and invalid reservation problems are also circumvented when compared to other protocols resulting in accomplishing greater QoS throughput.

REFERENCES

[1] J. Kay., J. Frolik, "Quality of Service Analysis and Control for Wireless Sensor Networks″. Submitted to the 1st IEEE International Conference on Mobile Adhoc and Sensor Systems (MASS2004), Ft. Lauderdale, FL, Oct.25-27, 2004.

[2] H. Badis, A. Munaretto, K. Al Agha, G. Pujolle. "QoS for Adhoc Networking Based on Multiple Metrics: Bandwidth and Delay″. In the proceedings of IEEE MWCN2003, Singapore, October 2003.

[3] C. Boulkamh, A. Bilami, A. Saib, M. Sedrati, "AODV_MC: Un Protocole de Routage AODV avec Minimum de Contrôle Routage Jeesi09, Alger 19Mai. 2009

[4] R. Ramanathan, R. Hain. "An Adhoc wireless test bed for scalable, adaptive QoS support″. In Proceedings of IEEE WCNC'2000, Chicago, IL, USA, 2000.

[5] R. Braden, L. Zhang, et al. "Integrated Services in the Internet Architecture: an Overview″. Juin.1994. RFC 1633.

[6] S. Blake, D. Black, M. Carlson, E. Davies, Z. Wang, W. Weiss. "An Architecture for Differentiated Services ″. Déc.1998. RFC 2475.

[7] I. Jawhar and J. Wu, "Quality of Service Routing in Mobile Ad Hoc Networks," Network Theory and Applications, Springer, 2004.

[8] T. Reddy, I. Karthigeyan, B. Manoj, and C. Murthy, "Quality of Service Provisioning in Ad Hoc Wireless Networks: A Survey of Issues and Solutions," Ad Hoc Networks, vol. 4, no. 1, pp. 83-124, 2006.

[9] M. Conti, E. Gregori, and G. Maselli, "Reliable and Efficient Forwarding in Ad Hoc Networks," Ad Hoc Networks, vol. 4, pp. 398-415, 2006.

[10] G. Chakrabarti and S. Kulkarni, "Load Balancing and Resource Reservation in Mobile Ad Hoc Networks," Ad Hoc Networks, vol. 4, pp. 186-203, 2006.

[11] A. Argyriou and V. Madisetti, "Using a New Protocol to Enhance Path Reliability and Realize Load Balancing in Mobile Ad Hoc Networks," Ad Hoc Networks, vol. 4, pp. 60-74, 2006.

[12] C. Shen and S. Rajagopalan, "Protocol-Independent Multicast Packet Delivery Improvement Service for Mobile Ad Hoc Networks," Ad Hoc Networks, vol. 5, pp. 210-227, 2007.

[13] Ze Li, Student Member, IEEE, and Haiying Shen, Member, IEEE, "A QoS-Oriented Distributed Routing Protocol for Hybrid Wireless Networks", IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 13, NO. 3, MARCH 2014.

[14] S. Ibrahim, K. Sadek, W. Su, and R. Liu, "Cooperative Communications with Relay-Selection: When to Cooperate and Whom to Cooperate With?" IEEE Trans. Wireless Comm., vol. 7, no. 7, pp. 2814-2827, July 2008.

