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Research paper



A Survey on Bandwidth Management in MANET

Nibedita Jagadev[1*], Binod Kumar Pattanayak[2], Debabrata Singh[3], Sipra Sahoo[4]

[1,2,3,4] ITER, SOA Deemed to be University, Bhubaneswar, India,
**E-mail: nibeditajagadev@soa.ac.in.:*

Abstract

Mobile ad-hoc network (MANET) are self-configuring without any fixed infrastructure. In MANET the challenge of providing QoS support during multimedia application is an open problem. To enhance the network throughput adequate amount of bandwidth is required. Bandwidth management in MANET plays a vital role in improving the networks overall performance. In this paper a systematic study has been carried out about challenging issues associated with bandwidth management during routing in MANET and analysis has been done about different models of bandwidth management.

Keywords:*MANET;Bandwidth Management;QoS*

1. Introduction

Mobile ad hoc networks are collection of wireless nodes that self-configure to form a network without any traditional infrastructure. Each node can move in a decentralized manner and dynamically connect with each other. They can be arbitrarily organized and cooperate to start communications dynamically by using limited network management and administration. Because of highly portable or static nature of mobile nodes the Ad hoc network may vary in terms of their uses and capabilities. They may be functional by linking to the Internet. The locations in which ad-hoc networks are originally projected to play an important role comprises of instant infrastructure scenarios, where mobile access to a wired network is either ineffective or difficult. Ad-hoc network are more flexible, and have the prospective to work as a ubiquitous wireless infrastructure. It is proficient of interconnecting thousands of devices, and supporting a extensive range of networking requests. Wireless mobile ad-hoc network is the focus of recent research. Since multimedia applications are required to provide Quality of Service (QoS) guarantees, study in providing QoS support is gaining attention. As a consequence, QoS routing is becoming an essential-tool in wireless network. Providing QoS in MANET is difficult due to the shared and open nature of the mobile ad hoc network. While these unique characteristics of MANET prevent wireless networks from providing the hard QoS guarantees, different mechanisms used in it can still increase the stability of the communication path. With the rising popularity of wireless multimedia applications and access technologies in mobile ad hoc networks, admission control and bandwidth reservation are highly required in such networks to avoid network congestion and thereby improving the performance of the overall network. This needs proficient solutions on available bandwidth estimation, QoS routing, admission control and bandwidth reservation. Based on these bandwidth parameter the quality of service problems in ad hoc networks are now widely considered, and more and more QoS protocols are proposed. To propose an efficient QoS routing, it is very essential to obtain exact information on the used and available bandwidth. Section 2 represents the motivation of preparing the article. Section 3 represents bandwidth management technique, section 4 provides research work done by eminent researchers in this field section 5 provides the proposed frame work and section 6 provides the conclusion part of this paper.

2. Motivation

There is an ever-growing need for data transfer. This drives most of the current works in bandwidth management area. The efficiency and behaviour of a MANET depends on how well information can be passed around and delivered. Bandwidth can be calculated in a network by referring the rate of data transferred on a link or path .Bandwidth is a very scarce commodity, so it is required to be handled in a methodical way. Network throughput can be enhanced by adequate amount of bandwidth. When the bandwidth is distributed some flows get the maximum throughput but some cannot even satisfy their minimum requirement. Since bandwidth is one of the major resource and if the bandwidth cannot be managed properly then the flow of information gets affected because of traffic, link failure, over and underutilization of channel. So it is a challenge for the research field to find the exact available bandwidth. Many bandwidth management methods has been proposed for better routing , to support reduction of delay and to provide better quality of service This motivates us to analyse bandwidth management in this paper .Bandwidth management is a dynamic approach that provides flexibility, probability and efficiency for real-world complex network communications. Different methods have contributed and calculated either with a simulation study, new algorithm or improved model which provides optimized solution under extensively diverse traffic load intensities for managing bandwidth. This paper presented a comparison and analysis of a literature review survey on bandwidth management in different network implementations. Here focus is given to allocation of bandwidth to different applications or flows during peak times which can avoid traffic overcrowding on a network.

3. Bandwidth Management Technique

Bandwidth management is a method of allocating bandwidth re-

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sources to different applications on a network. Without bandwidth management, a particular flow for different users can take control of all existing bandwidth and check other applications or flows from using the resources. Applications can also require a specific measure and excellence of service (QoS) that cannot be predicted in real time traffic on a network.

4. Study and Analysis of Bandwidth Management Approaches in MANET

The congestion caused in the network due to bandwidth is an important factor which affects the performance in a mobile ad-hoc network. Different bandwidth management techniques in ad hoc network are used. The first approach is measurement based approaches, the second category is model based approaches and the third category is calculation based approaches. The rest of the part includes a short depiction of the above techniques.For avoiding congestion and providing feasible way to guarantee QOS requirement an intelligent protocol is designed known as BROWN (bandwidth reservation over ad-hoc wireless network). In this scheme [1] bandwidth reservation mechanism is integrated with call admission control. In this paper the BROWN scheme is applied to the OLSR routing protocol to provide better QOS requirements. It also can be integrated with other protocols that use proactive approach. Simulation analysis of this protocol is done using NS2 and the experimental results show that using this reservation scheme node can communicate to neighbours using different communication rate and it provides a possible way to avoid congestion and guarantees QOS requirement of existing links.

To achieve timeliness and reliability in highly mobile MANETS is a difficult task. To preserve the QOS guarantee, by limiting the transmission rate to significantly reduce contention in a shared network, where there is frequent topology change is presented in paper [2]. This paper gives a brief idea about dynamic bandwidth management (DBM) approach DBM logic is divided into two parts first part deal with arriving messages and the second part deal with the bandwidth reservation. In this approach if the transmission rate of the arriving data message does not exceed the obtainable bandwidth then the flow is allowed otherwise the packet broadcast is delayed. By restricting the communication rate the congestion can be avoided. This approach can work under very highly mobile node and can be applied to any routing protocol. This is implemented in the NS2 implementation of AODV it gives lower latency and higher reliability then the original AODV protocol.

Due to increase in real time application the issues to ensure service guarantee in ad-hoc network is a challenging task .Whenever a new task is admitted it should not go beyond the network capability, but this goal is difficult to achieve because the path is not involved in between two nodes it is extended to all nodes within a definite carrier sensing range[CSR] To reduce the message over head in this paper[3] one admission control scheme is proposed along with one bandwidth management protocol. Here admission control is done in route request and route reply phase. The bandwidth up to two hop can be calculated, if the required bandwidth by a flow is within the channel capacity then the new flow is allowed otherwise it is dropped. Once a link is established the data packets and its associated packets can flow .Here the bandwidth management protocol inserts two fields in the IP header packet to refresh and free the bandwidth along the path .In case of failure of link the source node tries to find alternative route for communication towards the destination. Here the proposed admission control method is incorporated with AODV so it don't have to keep the record about the whole path like CACP and RPR.

MANETS face a lot of technical challenges so to handle the network traffic in MANET need a proper management of available resources. Bandwidth is an essential resource of wireless network. In this paper [4] a dual bandwidth estimation method is proposed by merging and enhancing the weakness of two traditional methods Listen bandwidth method and Hello bandwidth method. Dual bandwidth estimation method provides better result than the two individual methods. The Listen bandwidth method or the busy time method can be used when there is no link failure and all the links are available. The channel busy time is the time interval in transmitting packets receiving packets or sensing packet transmission. The main disadvantage of busy method is when there is a link break the bandwidth cannot be released so to overcome this problem Hello method is used. Hello bandwidth method is used when there is a link break. There is a problem encountered when there is a hidden node and in that case Listen method is used. The dual bandwidth estimation method will switch among the two procedures depending on the network condition. The dual bandwidth estimation method is using simulation modelling and the code is written using C++.

To avoid the constant degradation in the performance of throughput bandwidth estimation is required. Accurate estimation of bandwidth improves the network performance. In this paper [5] accuracy in available bandwidth is improved by using stochastic process model. Here the proposed model estimate the bandwidth using the service process and effective service curve for a variable bit rate [VBR] traffic. Here the estimation of service method is done using the random variables such as the arrival rate, the departure rate and the packet type of the flow. Then using the effective service curve, service process and the priority of the incoming data bandwidth is allocated.In some situation there is no enough space for QOS flow .So to provide guarantee for QoS with other criteria's evaluation of available bandwidth must be there .The main idea of this paper [6] is to offer a cross layer QOS mechanism which can control the best effort traffic and make the space for QOS traffic. In this paper the author has proposed a new cross layer protocol named DRBT (dynamic regulation of best effort traffic) which can order the best effort traffic when it is required. Each time a new QOS flow is allowed using ABE the available bandwidth is estimated and if the required bandwidth is not satisfied then using a DRP packet the best effort traffic is regulated. In the link layer the DRP activates the throughput reduction mechanism for best effort traffic. From this it is concluded that DRBT efficiently manages bandwidth for QOS transmission by dynamically adapting the rate of best effort traffic.

To evaluate the available bandwidth between the nodes become difficult because of the interference and the shared nature of the network. In this paper [7] the calculation based approach is considered where the two adjacent nodes try to find out the idle channel time to get more accurate AB. Here IAB (improved available bandwidth) has been proposed. IAB considers the synchronisation between sender and receiver and differentiates between BUSY and SENSE BUSY state to find the idle channel time.

The major drawback of MANET is its mobile nature which results in frequent link failure and less throughput. To defeat this challenge in this paper [8] authors have planned one model known as BWCM (bandwidth control management model). This algorithm includes a bandwidth controller .The controller determines whether a new flow can be allowed or not according to the availability of bandwidth without affecting the existing flows. Then bandwidth is calculated using the bandwidth calculation algorithm. Using the proposed algorithm different paths has been chosen from the source to the destination. From the selected path the path which have the highest bandwidth will be elected for the communication. When a communication failure is found in the elected path then another path is chosen for communication.

Here the author has presented one protocol called MPARC (multi priority admission and rate control) .This protocol [9] provides QoS guarantees to real time traffic in the occurrence of best effort traffic. Due to the shared nature of the wireless medium the obtainable bandwidth estimation is done by two ways the local accessible bandwidth and the neighbourhood available bandwidth. The bandwidth allocation model proposed here will provide information about bandwidth sharing. After that priority based admission mechanism is done for real time flow controlling. Here the bandwidth model calculates for saturated unsaturated and semi saturated networks more accurately using MPARC. But here delay

of packets after arrival of a new flow is not considered.

Wireless network are multi hop and fast deployable. To give a QoS guarantee the bandwidth information along the path is important. Due to mobility and flow dynamics the network resource administration is difficult. Here the nodes are very dynamic so change of network topology makes the link bandwidth to zero. If the link load increases the interference in the link also increases. In this paper [10] author has utilised load statistics to approximate present network residual bandwidth. One CAC (call admission control) procedure is introduced before TCP/UDP layer. Here the average of idle slot during the frame is to be calculated by getting the slot condition of the neighbour. Before allowing a flow the available slots of each link path is calculated, if the required bandwidth is less than the link path bandwidth then it is allowed otherwise the flow is rejected. Here every time the path bandwidth is to be calculated before the routing information exchange. One new routing algorithm has been proposed using this statistical method and the DSDV routing protocol.by combining this method with other routing protocols can also give better QoS support.

Nowadays multimedia traffic has gained a tremendous importance. Bandwidth is a scarce commodity so it needs to be managed. In this paper [11] a QOS model has been proposed which differentiates the flows into higher and lower priority classes the model has different resource management functionalities as, admission control module and bandwidth adaptation module. According to the priority of the flow the least priority flows are given minimum required bandwidth. The remaining resources are given to a high priority new flow. If after that the remaining resources are insufficient then least priority flows are to be paused and release their acquired resources, if then also the problem persists the system goes into panic mode. In panic mode the flows starting with least priority flows will be stopped until the required resources are available. Availability of bandwidth can be enhanced with the adaptation module as a result a new flow can enter and efficiency will increase.

In QOS system distributed fair scheduling is done with the help of the scheduler when traffic characteristics change .in this paper [12] the author has tried to decide the traffic weight and regulate them as traffic quality change. Here one bandwidth manager is proposed which allocates channel time proportion and share the network bandwidth for each flow at the beginning of the connection. It refuses a flow if its bandwidth requirement exceeds the network capacity. In this paper author has proposed one bandwidth management system architecture using a bandwidth management protocol, rate adaptor and per node total bandwidth estimator which manages the flows to give maximum throughput.

Providing high throughput, low delay service is a necessary part of multimedia application. Several related parameters are required to get the optimal path from source to destination for a better QoS approach. Here in this paper [13] the author has differentiated the multimedia traffic to audio video and data. To provide QOS assurance in MANET for different traffic different path has been chosen. The proposed mechanism consists of two main parts route discovery and route maintenance and recovery. For a particular application different dynamic parameters are used to get the optimised route from source to destination. This gives better performance than AODV protocol.

Now a days wireless devices mostly in use because of their support to the multimedia based applications. For communication of data bandwidth is mostly required. All the applications are bandwidth hungry. In this paper [14] a protocol is implemented known as HMQ ant (Hybrid multipath QoS ant).The author has optimised the bandwidth to find a path for effective transfer of multimedia traffic. Here the path having maximum bandwidth from source to destinations to be found out. For this the source node sends forward ants, when forward ant passes the intermediate nodes collects the available bandwidth and compares it with the required bandwidth. Minimum of all available bandwidth is global minima and minimum bandwidth available at each node is the local minima. If the required bandwidth is less than the available bandwidth only that path will be chosen otherwise the same procedure is repeated to find the next path. The master node [MPR] are used for flooding of data instead of all the nodes, so less overhead is found. Every intermediate node choose the next node towards the destination depending on the value of the pheromone, the heuristic function and the average delay of its neighbour.

A new approach has been proposed in this paper [15] called as quality of service mobile routing backbone over AODV (QMRB-AODV). Here the route which can support QoS between the source and the destination is to be found out. The traffic is distributed in the network and the control message is reduced using the QMRB-AODV protocol. The nodes in the network are differentiated into simple routing nodes (SRN) and QoS routing nodes (QRN). Mobile routing backbone (MRB) is formed using some features of nodes such as CPU, power of battery maximum available bandwidth .RREQ is propagated from one hop to other. The path to the destination is chosen having lowest number of nodes and highest owed bandwidth. The QMRB-AODV makes better use of bandwidth by distributing the flow throughout the network.

For improving quality of service of MANETS proficient resource reservation is necessary. Real-time flows in ad-hoc network require bandwidth reservation because maintaining a constant bandwidth for best effort traffic is difficult. In this paper [16] the data packet can be forwarded in the path where there is least cost, congestion and availability of bandwidth. Packet can be forwarded from one node to another if accessible bandwidth is more than bottleneck bandwidth in the link, otherwise bottleneck bandwidth is replaced by available bandwidth. Traffic policing and rate monitoring and adjustment is done by rate control technique. From this paper we can conclude that resource allocation procedure reduces the packet loses and enhances the throughput.

Two traditional methods [17], hello method and listen method has been compared and it was concluded that hello method adds overhead by adding neighbours bandwidth utilization information but listen method does not add any extra overhead the drawback of listen bandwidth estimation is when there is a link break it does not release the bandwidth immediately so the author in the proposed method have used advantages of both the methods. In the proposed method directly the bandwidth will be released when a route breaks and there is no overhead caused by attaching neighbour's bandwidth spending information.

A modified opportunistic routing protocol has been proposed which is based on cross layer design and mainly focus on energy harvesting principles named as modified energy harvesting opportunistic routing protocol [19,20]

The QoS provides audio, video, multimedia in MANET. Due to the multimedia service congestion in a specific path is high and packet drop rate is also high, due to the extra overhead. So in real time application AODV protocol fails to provide required QoS. In this paper [18] the author has used cuckoo search algorithm to find the best path to send the packet by considering residual energy, hop count and routing load as the parameters instead of taking hop count as a parameter to find the shortest path. Here one protocol CS_AODV has been proposed this algorithm gives a better performance of QoS in MANET in condition of mobility, scalability and congestion.

To solve the multi constrained quality of service routing problem in MANET a hybrid intelligent algorithm has been proposed by the author by integrating two different heuristic techniques The QoS routing problem is optimized by taking some cost function. In this paper [21] the author has taken some of the practical constraints such as delay packet loss, bandwidth and jitter. Here tuned cuckoo search algorithm is presented and it gives better result in 3 different performance metrics as packet deliverance, path success ratio and average end to end delay. So tuned-CSA provides better QoS routing.

Due to change in network topology in MANET achieving reliable multicast transmission is crucial. Backpressure restoration technique has been used to deal with network failure and send a message ant with information regarding failure of link [22]. Here two ants are used one is the load ant and another one is the strategy ant .The load agent uses the path information and the strategy

agent controls the load agent. This protocol proves that it gives a better result in path set up, dynamic path maintenance, and congestion control and bandwidth utilisation.

5. The Proposed Frame Work

The main functionalities of resource management in mobile Ad hoc Networks are Resource Estimation, Admission control and resource Reservation. The resource should be handled in a proper way to avoid the wastage of resources. The table 1 illustrates the flow management framework to dynamically distribute traffic for optimal bandwidth management.

Table 1:FRAMEWORK OF OPTIMAL BANDWIDTH MANAGEMENT

Flow Table				
Flow ID	Source	Destination	Minimum Requested Bandwidth	Allocated Bandwidth
Flow 1				
Flow 2				
Flow3				
……				
Flow n				
Bandwidth Management				
Total Available Bandwidth				
Bandwidth Consumed				
Available Bandwidth				
Request				Accepted / Rejected

Here the traffic is differentiated into distinct flows depending on their quality of service requirement. The framework gives the highest priority to the real time traffic. The flows those are admitted first are given the maximum requested bandwidth. When the available bandwidth is not sufficient for incoming flows, the bandwidth manager requests the on-going flows to adapt with their minimum requested bandwidth and release the remaining bandwidth. Now the bandwidth manager will calculate the released resources in order to allow the new flows. If the remaining resource is not enough then the network should start stopping the flows until the system state has been restored to a non-congested state.

6. Conclusion

In this paper a complete survey on bandwidth management has been done using different methods and considering different parameters. Importance has been given to the models which help in better use of the scarce commodity bandwidth. More stress has been given on those models which are implemented in a successful way when there is a highly mobile network and the simulation result showed better result such as increased throughput, less delay and enhanced quality of service requirements.

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