Survey and Proposed Methodology for Qos Improvment in MANET

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Abstract— Mobile ad-hoc network is dynamic nature because each node moves freely in the network. In such a situation network performance is very important, due to complicated situations such as node/link interference and traffic load, quality of service support in multi-hop multi-rate ad hoc networks remains a challenging issue. Furthermore, when mobility is present, because of frequent route change, it is even more difficult to maintain high level performance for existing real-time flows that may not tolerate serious performance degradation. In this paper we provide survey about various issue involving in QoS effect in the network with routing protocol and various performance metrics, so we analyze the performance of the network and increase the performance of the MANET.

Index Terms— *QoS, Routing Load, average end-to-end delay, packet size, back off, scalability and AODV*.

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1 Introduction

A mobile ad hoc network (MANET) is a mobile wireless network that is formed spontaneously. It is a collection of autonomous mobile computing nodes that communicate with each other over packet radio and without using any existing network infrastructure, and thus to be self creating, self organizing, and battery-powered. Unlike the traditional wireless networks, communication in such a decentralized network is typically multi-hop, with the nodes using each other as relay routers without any fixed infrastructure. This kind of network is very flexible and suitable for applications such as temporary information sharing in a conference, military actions and disaster rescues. However, multi hop routing, random movement of mobile nodes and other features unique to MANET lead to enormous control overhead for route discovery and maintenance. In some scenarios, the routing maintenance overhead may consume so much resource that it seriously compromises long term efficiency. Furthermore, compared with the traditional networks, MANET suffers from the resource constraints in energy, computational capacities and bandwidth. All of these make routing in MANET a very challenging problem.

To address the routing challenge in MANET, many approaches have been proposed in the related work. Based on the routing mechanism for the traditional networks, the proactive approaches attempt to maintain routing information for each node in the network at all times (e.g., [1] [4]) whereas the reactive approaches only find new routes when required (e.g., [2] [3]). Other approaches make use of geographical location information for routing (e.g., [5]). In most of the previous works, the number of hops is the most common criterion to determine routing. However, in MANET, shortest path (or minimum hop count) routings such as DSDV [1] and AODV [2] produce some areas of the network that are likely to have higher data loads than other areas, especially at the central network. This can make certain areas prone to congestion, thus decreasing the overall network performance. In such case, the criteria or metric based on the number of hops will not suffice for making routing decisions.

One other major application of MANETs is battlefields besides that MANTE's are also used for meetings, sports stadiums and in Personal Area Networks. In this paper our focus to study about various MANET routing protocols and QoS parameters and gave a clear idea which protocol performs better in aspects of QoS as per various parameter base.

2. RELATED WORK

This section we provide survey about various routing protocol that uses in MANET with QoS provision.

N.Sumathi et al. his proposed "Pipelined Back off Scheme for Bandwidth Measurement in QoS Enabled Routing Towards Scalability for MANET's" [6]. in this mechanism its reduce the overhead associated with collision and to improve the accuracy of available bandwidth. After estimating the available bandwidth, this
between source and destination with bandwidth as an additional constraint. Pipelined back off stages consume less bandwidth which is negligible. Performance of QoS routing is evaluated based on the bandwidth information obtained from the MAC layer. It makes the utilization of resources more efficient by minimizing the unnecessary control messages and

stopping the traffic that cannot meet the given QoS requirements.

Muhammad Naeem et al. proposed "QOS Based Performance Evaluation of Secure On-Demand Routing Protocols for MANET's" [7]. In this work researcher evaluated two secure routing protocols Ariadne and SAODV for the mobile Ad-Hoc networks (MANETs) with the performance metrics on basis of following quality of service parameters like delay, jitter, routing overhead, route acquisition time, throughput, hop count, packet delivery ratio using Manhattan grid and random waypoint mobility models. And conclude that Ariadne performs better in term of route acquisition time and routing overhead over the SAODV. But SAODV is required to decrease the processing requirements to tackle hash chains and digital signatures to implement the security.

Ming Li , B. Prabhakaran, proposed "reliable QoS in multi-hop multi-rate mobile ad hoc networks" [8]. In this paper, researcher focus on the issue of providing sufficient QoS in networks with moderate to high node mobility.

Rei-Heng Cheng et al. proposed "A highly topology adaptable ad hoc routing protocol with complementary pre-emptive link breaking avoidance and path shortening mechanisms" [9].This paper proposes integrating the DLBA and DPS mechanisms into a modified AODV protocol by developing a pair of parameters to determine the timing for activating DLBA or DPS so that the two algorithms can work cooperatively and complementarily together. The new protocol can significantly improve the performance of the original AODV routing protocol and can also adapt itself well in a very dynamic network environments according to simulation results. Overall, the new protocol is capable of maintaining higher link quality, achieving higher data delivery rate with less average delay time, while incurring much less network overhead. appropriately mitigating the impact of the network dynamics on the validity of established routes. Secondly, they set up a common framework for the comparison

between three families of proactive routing: the shortest path-based routing, the most stable path-based routing and they proposed most stable constrained path routing.

Matthew Johnston et al. work in "On the Impact of Transmission Radius on Routing Efficiency"[11]. This paper presents a model for studying the effect of transmission range control on route efficiency in ad hoc networks, both in terms of maximal throughput and minimal energy expenditure. They show that allowing for per-packet variable power control greatly improves the average efficiency of multi-hop, unicast transmissions. For two-level power control, they compute near optimal values for the two transmission radii to maximize performance. A new local, position based routing protocol is designed based on partial network information. They show that as nodes have more information about the network, better routing decisions are made.

They find a threshold in location information such that when a node knows the location of other nodes within a certain distance of itself, it makes high quality, local forwarding decisions.

Adnan Agbaria et al. proposed "Efficient and Reliable Dissemination in Wireless Opportunistic Networks by Location Extrapolation" [12]. In this work, they have investigated the benefits of utilizing location information in dissemination protocols. In particular, they have presented a new approach that utilizes positioning information in order to generate an efficient dissemination tree while only maintaining 1-hop neighbourhood information.

Pattana Wannawilai et al. proposed "AODV with Sufficient Bandwidth Aware Routing Protocol" [13]. In this paper, researcher propose a new improved version of Ad hoc Ondemand Distance Vector (AODV) that uses a light-weight mechanism to determine network congestion. It is based on the information acquired from the MAC layer, to improve algorithm performance. This algorithm which they call AODV+SBA uses the concept of congestion avoidance that prohibits the new route to allow additional traffic coming into the congested area.

Its algorithm adopts the cross-layer design approach by utilizing parameters from different layers to achieve overall system optimization. The parameters for measuring local network congestion around a node depend largely on the MAC layer. In this paper, they focus on the IEEE 802.11 DCF mode, since it is the most widely used wireless LAN standard. By using the wireless medium information from the MAC layer, AODV+SBA prevents the discovery of routes over which it is undesirable to carry additional data and routing traffic since the wireless medium over those hops is already very busy.

3. QUALITY OF SERVICE IN MANET

Unlike fixed networks such as the Internet, quality of service support in mobile ad hoc networks depends not only on the available resources in the network but also on the mobility rate of such resources. This is because mobility may result in link failure which in turn may result in a broken path. Furthermore, mobile ad hoc networks potentially have fewer resources than fixed networks. Therefore, more criterions are required in order to capture the quality of the links between nodes.

We believe for mobile ad hoc networks, with time-varying low-capacity resources, the notion of being able to guarantee hard QoS is not plausible. Instead, applications must adapt to time-varying low-capacity resources offered by the network. Therefore, the quality of service that an application requires depends on the "quality" of the network.

This "quality" should be a function of available resources resides both in the wireless medium and in the mobile nodes in the network as well as the stability of such resources. Hence, quality of service in mobile ad hoc network could mean to provide a set of parameters in order to adapt the applications to the "quality" of network while routing them through the

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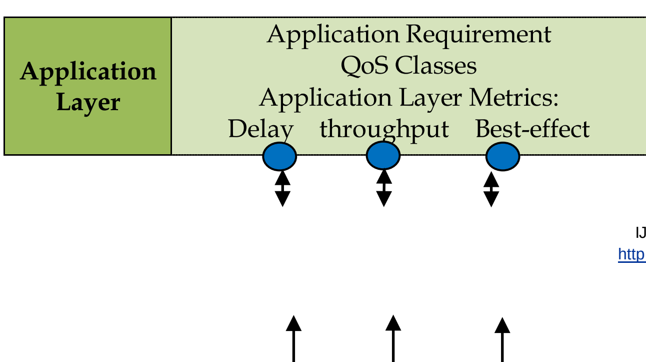
network. Therefore, quality of service routing is a routing mechanism under which paths are generated based on some knowledge of the quality of network, and then selected according to the quality of service requirements of flows. Hence, the task of QoS routing is to optimize the network resource utilization while satisfying application requirements [14].

4. A CROSS-LAYER QUALITY OF SERVICE MODEL

Here we discuss for applying a cross-layer quality of service model that separates metrics at the different layers (i.e. application layer metrics, network layer metrics, and MAC layer metrics) and mapping them accordingly [15, 16]. This is because the quality of service that an application requires depends strictly on the "quality" of the network. As stated earlier, the quality of network should represent the available network resources reside both in the wireless medium and in the mobile nodes as well as the stability of these resources.
At the application layer, they propose to classify the QoS requirements into a set of QoS priority classes with their corresponding application layer metrics (ALMs).
For example, if we classify application requirements into three QoS classes, I, II, & III, and map them to appropriate metrics. Class I corresponds to applications that have strong delay constraints, such as voice. This class is mapped to the delay metric at ALMs. Class II is suitable for applications requiring high throughput such as video or transaction-processing applications. Similarly, we map this class to the throughput metric at the ALMs. Finally, Class III has no specific constraints, and it is mapped to best-effort at the ALMs. This mapping is shown in Fig. 1. At the network layer, we recommend to use nodes' power state, buffer state, and stability state to characterize the quality of network (see Fig. 1), and we call them network layer metrics (NLMs). The power level represents the amount of available battery over time (i.e. energy). The buffer state stands for the available unallocated buffer. The stability means the connectivity variance of a node with respect to its neighboring nodes over time. To compute the quality of a path, concave or/and additive functions have to be used in order to represent the NLMs of a path given the value of these metrics for individual nodes on that path.



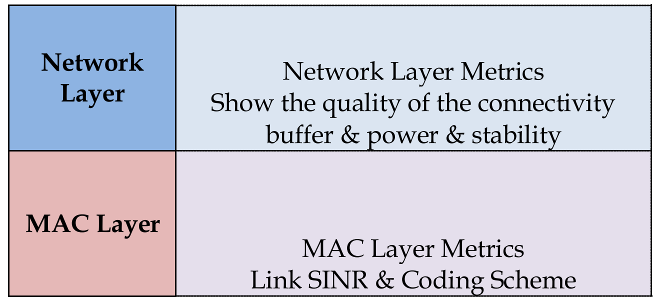


Figure 1: Global view of a cross-layer quality of service model

The network layer metrics of a particular node can also reveal whether the node is forced to be selfish or not. In the selfish mode, a node can cease to be a router and acts only as a host due to its poor quality.
At the MAC layer, the quality of network could mean link signal-to-interference plus noise power ratio (SINR), and we call it MAC layer metrics (MLM). Link SINR determines the communication performance of the link: the data rate and associated probability of packet error rate or bit rate (bit error rate BER) that can be supported by the link. Links with low SINR are not typically used due to their poor performance, leading to partial connectivity among all nodes in the network. Moreover, it is essential to minimize the volume of traffic being transmitted over the wireless interface because of the scarce wireless resources. This can be achieved via coding schemes. That is why we suggest applying different coding schemes such as FEC and ARQ for different QoS classes [17]. For example, forward error correction (FEC) uses a coding scheme for both error detection and correction which impose constant overhead over the applied data. This scheme is more appropriate for a high priority class, e.g. class I. On the other hand, automatic repeat request (ARQ) only uses an error detecting code; where in case of error, a packet is retransmitted. ARQ is feasible as long as the channel bit error rate is not too high and retransmission delay is admissible. The ARQ is more suitable for low priority class, e.g. class III. Hybrid ARQ/FEC techniques take the advantage of the two schemes. If the error in a packet cannot be corrected by the error correcting code, a retransmission will be demanded. We suggest to apply this technique for the medium priority class, e.g. class II. However, it is important to keep in mind that the bandwidth savings are a trade-off against the processing requirements on the mobile nodes. Hence the complexity of the coding algorithms must also be considered.
Indeed, NLMs and MLM determine the quality of links in order to generate the paths with good quality. They try to evenly distribute the traffic in the network and avoid paths with a low quality regardless of the application. Then, application layer metrics select exactly one path out of the paths with the good quality which is more likely to meet application requirements. This implies that applications may need to adapt to the quality of network. That is why, **Christian Bonnet et al.** propose a cross-layer quality of service model in order to responds to both network and application requirements. This model does not define specific protocols or implementations.

5. DISCUSSION ON ENHANCED QOS AODV

MANET form dynamic topology with each node contains routing functionality but MANET survives through various crises from physical layer to application layer because that work under the wireless communication with dynamic nature and no any centralize controller.

For Physical and MAC data dropping resolve through RTS (request to send) and CTS (Clear to send method) both resolve collision problem and MAC Busy, next we minimize queue full case drop through the alternative path mechanism, alternative path provides the communication between source to destination through more than one route if one route heavy loaded so we use alternative route and transmit data to destination that case we modified AODV routing protocol after this approach we improve the performance through transport layer, in communication transport layer work as gent between actual data and routing layer but also that layer provide guarantee of data delivery if we apply TCP protocol.

In TCP also survive through data drop, congestion, and retransmission time out problem, all those problem solve through bandwidth estimation technique, in that case we apply the mechanism for acknowledgment based bandwidth information in particular time interval so that sender send data according to bandwidth and if available bandwidth is less than the required bandwidth than sender minimize the data rate or increases the delay between data or alternative path use. All the above approach gathers into single module and improves the network quality of service privation.

6. QOS CONSTRAINTS FOR COMMUNICATION

A QoS constraint is a lower or upper numerical bound referring to a QoS metric. If a path is feasible with respect to a QoS constraint, this means that the path's value regarding the chosen metric does not cross the given boundary.

This criterion refers to whether a QoS routing protocol is capable of finding a route satisfying a single QoS constraint only, or if it can take multiple constraints into account at the same time. Finding an optimal route that satisfies multiple constraints simultaneously is inherently hard and of complexity NP [19].

Therefore, most routing algorithms that consider multiple constraints do not try to find the optimal path but rather any path satisfying all constraints.

6.1 Reservations: Guarantees for satisfaction of QoS constraints along a route can only be given if resources are reserved along this route. This classification criterion indicates whether a QoS routing protocol just determines a feasible route (no) or also takes reservations into account (yes), by providing own reservation functionality or by using other protocols, e.g. RSVP [20]. Of course, in wireless networks, the compliance of these guarantees also depends on the stability of the routes and the dynamics of the network topology.

6.2 Link properties: Some routing protocols require bidirectional links. Two node a and b are linked bidirectional, if there exist two unidirectional links between them, (a, b) and (b, a). If a routing protocol relies on bidirectional links, this often means that either if a feasible path was found, the same path is used for backward communication, e.g. for confirmation of a path, or that the reception of packets has to be acknowledged.

6.3 Net state determination: The term net state can cover topology information about the whole network or part of it, e.g. about all nodes in 1-hop range. This may include geographical information about a node's position and topology information about links between nodes, combined with information about QoS metrics for nodes or links. Many routing protocols need part of this information to determine a feasible route for given constraints.

6.4 Packet size: This denotes the amount of information that is exchanged per packet to update other nodes in a worst case scenario. For example, if packets with net state information should include a full list of a node's 1-hop neighbors, the packet size complexity would be O(n) for a network with n nodes, because they could be all in range of each other. O(1) denotes a fixed packet size, independent of, e.g., the number of nodes in the network.

Together with the communication complexity, information about packet size allows the estimation of an upper bound of data that has to be exchanged between the nodes to update net state information.

6.5 Storage Complexity: This denotes the amount of memory necessary to store net state information in a worst case scenario. This value cannot be estimated by means of communication complexity and packet size, because received information does not necessarily need to be stored completely and storage complexity may also cover information gathered locally.

6.6 Route discovery: A route between two nodes consists of a list of nodes (n_1, n_2, . . . , n_m), $m \geq 2$, where n_1 denotes the source node, n_m denotes the destination node, and a link exists between each two adjacent nodes in the list. Using this route, each packet from node n_1 with node nm as destination will be sent to node n_2, which itself will send the packet to node n_3 and so on, until it reaches node n_m. These routes have to be discovered, either in advance or while sending the packet.

6.7 Routing Type: There exist different strategies for route discovery in routing protocols.

For source routing, the source node determines the route a packet will take on its own; for that, the node needs sufficient knowledge about the network's topology.

While this is no problem in small- to middle-sized networks with static topology or low dynamics, it is in most cases not suitable for MANETs with higher dynamics due to scarce bandwidth for exchange of topology information and long propagation times. Here, often, distributed routing on a hop-per-hop basis is used. This means that each intermediate node

decides which of its 1-hop neighbors should receive the packet. This is not limited to sending the packet to exactly one neighbor, as different approaches may also flood the network or split up the route to increase the chance of successful delivery. A type of routing often used in large networks is hierarchical routing. Here, the complexity of the routing problem is reduced by dividing a network into a hierarchy of smaller networks, where each level is responsible for its own routing (divide and conquer-paradigm).
Most protocols surveyed and discover the routes reactively, i.e. route discovery is done when a route is needed. If feasible routes are determined in advance, this is called proactive route discovery. While this method has the advantage that routes are already present when needed, it has severe drawbacks in mobile networks.
Due to the dynamics of the network topology and long propagation times, the chance of outdated topology information and broken routes is too high to efficiently determine routes in advance. Some protocols use a hybrid approach, combining elements of both proactive and reactive methods.
Some protocols try to satisfy the QoS requirements (e.g. bandwidth) by finding a multi-path between source and destination node A multi-path denotes a path between two nodes that may split up and optionally reunite.

6.8 Scalability: This indicates whether a routing protocol can still be used efficiently with increased network size. Especially protocols with high complexity can experience difficulties with growing network size. As values for this criterion, we use low, medium, and high.

6.9 Performance Assessments: To assess a routing protocol, additional information beyond the protocols description and its algorithms is needed. This can be a theoretical analysis of a protocols complexity, a simulation (or series of simulations) of the protocols behavior in a simulated environment, or an implementation of the routing protocol used on real hardware [21].

7. SIMULATION ENVIRONMENT

The simulator we have used to simulate the ad-hoc routing protocols in is the Network Simulator 2 (ns) [22] from Berkeley. To simulate the mobile wireless radio environment we have used a mobility extension to ns that is developed by the CMU Monarch project at Carnegie Mellon University.

Our simulation model has five major components: ad hoc mobile network formation, packet delivery event generator, mobile nodes migration engine, routing protocol engine and statistics analyzer, as illustrated in Figure 2.
The module of ad hoc mobile network formation takes in parameters of the space boundary, number of network nodes, their positions in space and their maximum transmission radius. This module is implemented using Tcl script. The network formation is the simulation ground for packet delivery and mobile node migration events. The number of active communicating flows can be varied and the mobile nodes' migration speed and pause interval is node dependent. These are parameters inputted at simulation setup. Both events are generated using Tcl script and are subsequently handled by the routing protocol engine.
Through the NS-2 we create the simulation scenario and take number of network parameter and then we improve the performance of the MANET using QoS based mechanism.

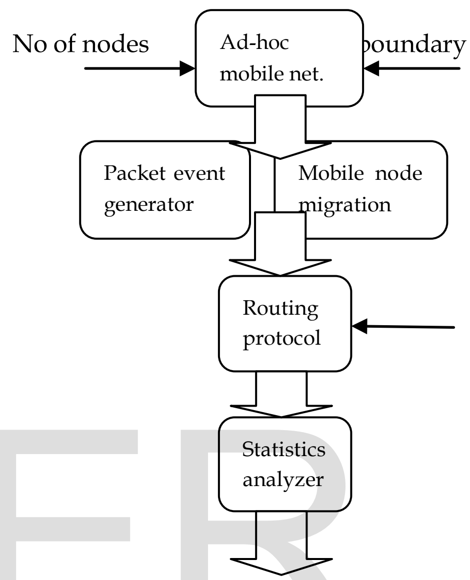


FIGURE 2: AN AD HOC MOBILE NETWORK SIMULATION MODEL

8. PERFORMANCE PARAMETER

This section presents the performance parameters used to evaluate the network behaviour and find out performance of the network after that we improve the performance according to quality of service provision. The main performance parameters are Routing message overhead, average end to end delay, and throughput. Under each main performance parameters, there are secondary performance parameters which affect it or depend on it.

8.1. Routing Load

The total number of routing packets transmitted during the simulation. For packets sent over multiple hops, each transmission of the packet or each hop counts as one transmission.

8.2. Average End to End Delay

This includes all the possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times.

It is calculated as the total summation of the division of total end to end delay (Dt) by the number of packets delivered (Npd) divided by the number of nodes (Nn) as in Eq.(1)

$$\sum \left(\frac{Dt}{Npd}\right) / Nn$$

8.3 Packet Dropped:

The routers might fail to deliver or drop some packets or data if they arrive when their buffer are already full. Some, none, or all the packets or data might be dropped, depending on the state of the network, and it is impossible to determine what will happen in advance.

9. CONCLUSION

In this paper, we provide a brief overview on the quality of service model in MANET with number of parameter that depends on QoS issue. We argue that QoS support in MANET is fundamentally different from traditional networks because of its particular behaviours. In this paper we also discuss about related work in the field of QoS improvement in MANET and various quality of service constraint such as reservations, route discovery, routing type, link properties, net state determination, packet size etc. after that we discuss about simulator to so in future we take network simulator and various given parameter and simulate the MANET improvement with QoS provision.

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