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Communication over Ad Hoc Networks under Quality of Services Constraints: A Review

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ABSTRACT: It is quite challenging to maintain the quality of wireless transmission over mobile ad hoc networks due to various factors i.e. error prone channel condition, behavior of intermediate layers, node's mobility, low radio frequency and insufficient bandwidth etc. To ensure the quality of Services for communication, there is need to resolve the individual issue. Researchers have developed various schemes to enforce the QoS provisioning over different layers i.e. application layer, physical layer, network layer etc. but each solution can resolve a particular issue only. In this research paper, we will explore the different methods to which can be used to ensure QoS enabled communication over ad hoc networks.

Keywords: QoS, MANET, MAC, Cross Layer

I. INTRODUCTION

1.1 Ad Hoc Networks

Quality of Service (QoS) defines communication standards for end user satisfaction. QoS provisioning suffers from various issues that occurs due to the dynamic nature of ad hoc networks. QoS deals with Throughput, Packet delivery ratio, control overhead and Delay factor etc. QoS may suffer from the behavior of individual layer as well as from the other factors like:

1. Poor channel conditions: In MANET, nodes use the shared channel. Due to unfair channel allocation, end user suffers from insufficient bandwidth.
2. Mobility: Nodes can freely move in a given network area. QoS may suffer due to the packet drop caused by high mobile environment.
3. Low Frequency Radio Links: Provision of QoS suffers as nodes operate on low frequency.
4. Limited Battery Backup: Nodes has small battery life. Energy of Intermediate nodes may be exhausted due to different network operations. If any node goes down, it may cause the frequent link breaks and end user suffers from poor quality of transmission.
5. Collision: MAC layer manages the access to wireless channel. If MAC fails to manage the collision level thus results in QoS degradation.
6. Congestion: As traffic load increase, congestion level also varies thus results in packet drop. Data loss at large level may cause the retransmission. Finally it results in unnecessary resource consumption.
7. Routing: If a protocol fails to adopt the dynamic environment of MANET, thus results in unstable route paths and it will also cause the extra control overhead.

Above are the critical constraints for QoS enabled communication. Now we will explore the various solutions developed by the researchers.

II. LITERATURE REVIEW

Following are the recent advancements related to ad hoc networks. It include the solutions related Quality of Services under performance constraints.

A. Venkataramana et al. [12] introduced a fuzzy logic method which can optimize the node traversal time which suffers from various factors i.e. node density and dynamic mobile environment. Proposed method takes these constraints as input parameters and produces output for traversal time. Experimental results show that optimal tuning of fuzzy logic can fulfill the QoS requirement of MANET.

A. Kout et al. [13] developed a new protocol to reliable communication over ad hoc networks, called AODVCS. First of all, current topology is determined and after that Cuckoo search is utilized to find out the shortest paths between source and destination. Simulation results show that it can maintain the packet delivery ratio and offer minimum end to end delay.

K. Zhou1 et al. [14] investigated the QoS issues related to multicast group communication and proposed a two phase method to control the bandwidth requirements for communication. In first phase, multicast routing tree is constructed and after that slots are allocated to each multicast tree link. This allocation reduces the extra control overhead and latency for packet delivery. Experiments show that as group size is increased, bandwidth requirement is also varied.

J. Keerthy et al. [15] enhanced the existing AODV protocol by introducing the priority method which can perform under QoS constraints. It supports multiple flows and assigns priority level to each flow

as per bandwidth requirement. A threshold value is used to regulate the data rate and transmission rate. If transmission rate exceeds from threshold value, transmission of low priority packets is halted and only high priority are transmitted. If transmission rate remains less than threshold, all packets are routed smoothly. Simulation results show that it out performs as compared to traditional AODV.

QoS plays critical role for real time applications. L. Baccouche et al. [16] introduced a cross layer method which combines the QoS requirements for network layer and application layer. Routes are selected on the basis of various parameter i.e. node's capacity, energy level and delay factor etc. Results show that it can adopt the variations in node's density, traffic load etc. Proposed scheme can be extended to support the real time traffic by introducing the control policy for packet scheduling.

C. Lal et al. [17] developed a framework to enforce the QoS provision for video streaming over wireless networks. According to the current demand bandwidth requirements are estimated and multipath routes are built on the basis of their life span. Short lived routes are avoided. Session admission control method is used to restrict the access to resources and communication is initiated only if sufficient bandwidth is available. For simulation purpose, H.264 codecs were used and results show that it can maintain the quality of video streaming. Proposed scheme will be extended to provide the Quality of Experience (QoE) for end users.

Multipath routing suffers from frequent link breaks. P. Periyasamy et al. [18] introduced an end to end reliable routing scheme for AOMDV protocol. This method also optimizes the energy consumption. Quality of links and energy levels for nodes are predicted simultaneously between source and destination. Simulation results show that it can deliver the data with minimum control overhead and energy consumption. Proposed scheme can be extended to provide the support for sensor and vehicular networks.

MANET utilizes the shared channel and its access is managed by MAC protocol. V.B. Subrahmanya et al. [28] explored the various channel scheduling methods and introduced a protocol which can collect the information about the unutilized slots of other nodes. These unused slots are further consumed by intermediate nodes and results show that it increases the channel utilization and delivers the data with minimum delay.

Communication over shared channel suffered from hidden and exposed terminal issues. H. Xu et al. [29] investigated deaf and directional hidden terminal problem and proposed a scheme. It supports medium access with busty tone which avoids the deaf and directional hidden terminals. It offers full bandwidth utilization and fair allocation of channel. Simulation results show its performance in terms of improved throughput. Proposed scheme can be enhanced to provide the support for geographical protocols those depends upon the directional antennas.

A. Bakhtin et al. [30] investigated the IEEE-802.11 MAC standard and offered a new MAC framework for wireless communication. It can distinguish the requirements of network layer as well as MAC layer. After gathering this information, it set the message priority and broadcast messages have the highest priority among all. Authors used a mathematical model to describe the contention level, delay factor and traffic rate. Simulation results show that it can reduce the delay but it cannot make the difference between the priorities of unicast and broadcast messages.

Energy is consumed by various network operations of ad hoc networks. K. R. Malekshan et al. [31] investigated the data transmission scheduling and its relationship with power consumption. Study shows that unfair transmission scheduling can consume more energy resources thus will result in short network life span. Authors developed a joint transmission scheduling scheme which requires optimal energy resources. Current links are schedule according to their interference level. Simulation results show that it consumes less energy and improves the throughput up to a significant level as compared to traditional scheduling methods.

Real time applications demands the QoS enabled transmission which is quite difficult to retain, if traffic flow varies. As the traffic load increases, transmission with best efforts leads to congestion over network. M. A. Gawas et al. [32] investigated the congestion over TCP protocol and developed a cross layer solution which can adjust the priority of TCP packets by exploiting the contention at MAC layer [24]. It also exchanges the data with PHY and network layer for performance optimization. Simulation results show its performance in terms of enhanced throughput with minimum delay as compared to EDCA.

III. CONCLUSION

In this paper, we investigated the basic requirements for QoS enabled commutation support over ad hoc networks. As per the survey, it can be observed that there is no single factor exists that can degrade he network performance. There are various issues at different layers which must be sorted out for QoS provisioning. Researchers considered these factors and introduced various schemes like: fuzzy logic based path travsersal, in rder to fulfill QoS requirements, AODVCS: protocols that offers reliable communication, two phase bandwidth management method for group communication, priority based flow control to fulfill bandwidth requirements, a cross layer solution by combining the features of Network and Application layers, QoS framework for real time data

streaming under bandwidth constraints, prediction of Quality Links under the constraints for frequent link breaks, enhanced MAC which utilizes the unallocated slots, Busty tone based robust solution to sort out hidden and exposed terminal issues, cross layer framework which interacts with MAC and network layer to ensure the QoS requirements, transmission scheduling to optimize the energy consumption and a cross layer solution to manage the congestion level by exploiting the data of PHY, MAC and TCP Layers etc.

Finally it can be concluded that, all above solutions were developed to address a particular problem and no researcher developed a single scheme to resolve the QoS conflicts. Some researchers have also discussed about the future scope of the proposed scheme. There is need to put more efforts to provide the QoS enabled data transmission over MANET, as its demands is increasing day by day.

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