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QoS Routing Protocols in MANETs - A Review

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Abstract: ***A Mobile Ad hoc Network (MANET) is an autonomous amalgamation of mobile nodes that form a dynamic network and communicating over wireless links. Owing to its unique abilities such as easy deployment and self-organizing capability, it has shown enormous potential in many applications. As MANETs popularity is increasing, their need to facilitate real time and multimedia applications is growing as well. Such applications have Quality of Service (QoS) requirements such as bandwidth, end-to-end delay, jitter and energy. Consequently, it is becoming very necessary for MANETs to have an efficient routing and QoS mechanism to facilitate these applications. There are several number of QoS routing protocols with distinguishing features that have been proposed recently. This paper presents a detailed overview of some of the QoS routing protocols along with their respective strengths and flaws. A comparative study of the QoS routing protocols is done and future prospects are also presented.***

Keywords: ***MANETs, QoS, Routing protocols, Ad-hoc networks.***

1. Introduction

A mobile ad hoc network (MANET) is a collection of randomly changing wireless devices (also called nodes) within a predefined area. Unlike in cell based networks, there is not any particular fixed base-stations for supporting routing and mobility management. The wireless nodes are equipped with individual wireless transmitter and receivers that facilitate communication with each other without using the help of wired base-stations. Since every transmitter have a fixed effective range, far away nodes communicate through multi hop paths with the help of using other nodes in the middle that serve as routers. These networks are especially suitable for run time emergent situations like warfare, natural calamities and other disasters where other infrastructure based networks are inefficient to operate.

Routing is one of the primary problems for data transfer between several nodes in networks. Several routing protocols have been under study for wireless networks, such as Dynamic Source Routing protocol (DSR) [1], Ad hoc On-Demand Distance Vector (AODV) protocol [2], Temporally Ordered Routing Algorithm (TORA) [3] that establish and maintain routes on a particular network with maximum efficiency possible. These protocols are restricted in a sense that they do not consider quality of service of the routes that they generate. By QoS we mean that they have to provide guarantee to the end to end node delivery in a diverse situations. This particular characteristic is missing from the above mentioned protocols.

A number of QoS routing protocols having distinguishing features are proposed in recent years. Most of QoS routing protocols are nothing but extensions of existing routing protocols, so they can be classified into two distinct categories: table-driven protocols (proactive) and on-demand protocols (reactive). In table driven protocols routing information is kept tall the time whether the nod is transmitting or not whereas in on demand protocols these information are not kept in advanced but are taken only when the node need to send data. In this research work, a few of the reactive QoS routing protocols have been studied which provide QoS using distinct approaches. The strengths and weaknesses of these QoS routing protocols have been discussed. Finally, a comparison of the routing protocols has been made to further facilitate research in this area.

The rest of the paper is organized as follows. In section II, survey of some of the diverse QoS protocols has been discussed. In section III, a comprehensive comparison of the QoS routing protocols based on certain parameters and features has been completed. Finally, section IV contains the conclusion and future work for the research community.

2. QoS Routing Protocol of Survey

A. Q-AOMDV

C.Wu et al. [9] presented an ad hoc on-demand multipath routing (Q-AOMDV), which provides Quality of Service (QoS) support, in terms of bandwidth, hop count and end-to-end delay in mobile ad hoc networks (MANET). The protocol uses path preference probability that is calculated by using the parameters such as delays, bandwidth, and no of hops to select the path for transmitting the packet. For discovering the route for the message the node gives the ROUTE REQUEST (RREQ) message to the entire network. Because of the flooding of this packet, several duplicates reach the destination. The destination node then sends the RREP packets back to the source that gives the source information about the routing mechanism to be used for further communication. The RREQ message that is received contains the several QoS parameters discussed above.

The performance of Q-AOMDV has been compared with AOMDV [10] by C. Wu et al. [9] and it performed much better than the existing AOMDV protocol for the metrics such as packet delivery ratio, normalized control overhead and end-to-end delay. This protocol has multi path capability which is providing way better data routing capability as compared to AOMDV.

B. TDMA Based Routing Protocol

D. Espes and Z. Mammeri [11] proposed a different cross-layer TDMA based routing protocol that satisfies the delay and bandwidth requirements in a network, and also optimizing the network throughput. The crust of the protocol is to reduce the number of neighbors attached with paths to optimize network throughput. In a wireless network, when a node uses a time slot, the neighbors of such a node could not use the same slot for sending or receiving data from other nodes. Also selecting paths having low number of neighbors creates less inconvenience among other neighboring nodes and thus results in more slots that could be utilized by nodes to establish connections.

For allocating the medium without collisions in a TDMA environment, the medium access time has been divided into super-frames. Every super-frame is further divided into two frames namely: - control and data time slots. Each node is then assigned a control time slot which is further used to transmit its control information and the remaining of the super-frame is utilized for data transfer. Furthermore it is important to reduce the number of hops in a path in addition to reducing to select nodes such as to reduce the no of neighbors. The protocol is an extension of AODV [2] protocol that relies on two procedures namely: route discovery and route maintenance. During the route discovery mode, the protocol makes a weight for determining weight free path. The route discovery and maintenance procedures typically use following metrics for each path: end-to-end delay parameter, bandwidth parameter and the number of neighbors parameters of all the nodes which are included in the path. These metrics are updated as per the information captured at link layer level.

C. Stable and Delay Constraints Routing (SDCR)

P. Yang and B. Huang [13] have proposed a very stable and Delay Constraints Routing (SDCR) protocol that extends the DSR protocol and adopts a very unique source routing mechanism. In the rote discovering mode, the protocol finds paths which meets delay requirement that have excellent link stability factor. In the route maintaining phase, it keeps monitoring the network topology change by means of delay prediction and performing repeat routing in time.

The SDCR has two major phases namely: - routing discovery and routing maintenance. In the routing discovery process the SDCR find all the possible paths between source and destination node and in the routing maintenance phase SDCR continuously monitors and predicts about the future information regarding availability of link. Link stability factor and delay constraints are taken into consideration in their routing discovery and maintenance phases. The SDCR has significant improved routing performance with the help of these route discoveries and the above said maintenance mechanisms which operate together and thus guarantees QoS.

The performance of this particular protocol was compared with the original DSR and DQR [14] by P.Yang and B. Huang [13] and the foregoing results showed that SDCR performance is better than the two protocols. SDCR helps in predicting the link available time as per the information of nodes and thus select the best route and in turn also meeting the delay requirement for sending the packets. Thus it helps in reducing the packet losses and guarantees a very reliable and rapid fast transmission.

3. Comparing the Protocol Based On QoS

The comparison of QoS routing protocols is shown in table 1 showing the comparison of the QoS routing protocols based on the below mentioned features.

Table

Protocol	*Multi-path*	*Cross layer*	*Stability*	*Bandwidth Reservation*	*Load Balancing*	*Power Efficiency*
Q-AOMDV [9]	Yes	No	No	No	Yes	No
TDMA based Routing [11]	No	Yes	No	Yes	No	No
SDCR [13]	No	No	Yes	No	No	No
DSRP [15]	No	No	No	Yes	No	No

4. Conclusion

As discussed in this paper QoS routing is an essential component of any QoS architecture. In this paper, a detailed survey of few of the QoS routing protocols based on different approaches has been undertaken. A thorough comparison of all routing protocols has been done and their respective strengths and feature based drawbacks of these protocols have also been considered for further exploring research in this field. It has been found that there are a several number of unsolved and unconquered feats that are yet to be achieved in this field. Some of these are maximizing accuracy, minimizing overhead, maintaining route, reserving resources, reducing power consumption and increasing security. Solving the above said issues will require designing of new QoS protocols.

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