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# Survey of QoS Based Routing Protocol for MANET's

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***Abstract: Mobile Ad Hoc Network (MANET) is collection of multi-hop wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The wireless links in this network are highly error prone and can go down frequently due to mobility of nodes, interference and less infrastructure. Therefore, routing in MANET is a critical task due to highly dynamic environment. A lot of research has been done in this field and new techniques have been developed. This research paper provides an overview of these protocols by presenting their characteristics, functionality, benefits and limitations and then makes their comparative analysis so to analyze their performance. The objective is to make observations about how the performance of these protocols can be improved.***

***Keywords: MANET, Quality of Service, AODV, Routing protocol, mobile node.***

## I. Introduction

Ad-hoc networks are a collection of mobile nodes that can be deployed without the need for any centralized infrastructure. Ad hoc network is very flexible and can configure itself automatically. It expands the current networks to more flexible situation. Since there is distributed infrastructure and therefore, no preinstalled routers which can forward packets from one host to another, this task has to be taken over by the distributed mobile nodes of the network. Each of those nodes takes equal roles, which means that all of them can operate as a host and as a router. As such, the very basic operation of these networks is dependent on the cooperation of their nodes to provide communication routes. In MANET, each node acts both as a router and as a host & even the topology of network may also change rapidly. Routing protocols for mobile ad hoc networks (MANETs)[2] have been explored extensively in recent years. Much of the work is besieged at finding a feasible route from a source to a destination without considering current network traffic or security requirements. The purpose of the studies was to manage an ad hoc network topology that always change and answer the problem of disconnected route (route error) caused by the level of mobility of the ad hoc node that cannot be predicted. Such distributed systems are prone to several security risks. When some nodes behave maliciously or in a selfish manner; the operation of the whole network can be severely affected. Consequently, the behavior of such nodes can result in degradation of the performance of the network or even disruption of its operation altogether.

## II. Challenges Of Qos Routing In Ad-Hoc Networks

Routing in general consists of two entities, namely the routing protocol and the routing algorithm .QoS provision in routing will lead to an increase in computational and communicational cost [7]. The improvement in network utilization leads to the increase in state information and the associated complexity and various issues are needed to be faced while providing QoS for MANETS. The major problems that are faced are as follows:

**Decentralized control:** The members of any ad hoc networks can join or leave the network dynamically and the network is set up spontaneously. So there may not be any provision of centralized control on the nodes which leads to increased algorithm's overhead and complexity, as QoS state information must be disseminated efficiently.

**Unpredictable channel:** The bit errors are the main problem which arises because of the unreliable wireless channels. These channels cause high bit error rate and this is due to high interference, thermal noise, multipath fading effects, and so on. This leads to low packet delivery ratio. Since the medium is wireless in the case of MANETs, it may also lead to leakage of information into the surroundings.

**Data Loss**: It refers when the data is loss or packet loss when the data is send from sender to receiver due to distortion.

**Route Maintenance:** The dynamic nature of the network topology and changing behaviour of the communication medium makes the maintenance of network state information very difficult. The established routing paths may be broken even during the process of data transfer. Hence the need for maintenance and reconstruction of routing paths with minimal overhead and delay causes. The QoS aware routing would require the reservation of resources at the intermediate nodes

**Node mobility:** Since the nodes considered here are mobile nodes, that is they move independently and randomly at any direction and speed, the topology information has to be updated frequently and accordingly so as to provide routing to reach the final destination which result in again less packet delivery ratio.

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**Low power:** The mobile nodes are generally constrained by limited power supply compared to nodes in the wired networks. Providing QoS consumes more power due to overhead from the mobile nodes which may drain the node's power quickly.

**Adequate security:** Security can be considered as a QoS attribute. Without adequate security, unauthorized accesses and usages may violate the QoS negotiations. The nature of broadcasts in wireless networks potentially results in more security exposures. The physical medium of communication is inherently insecure. So we need to design security-aware routing algorithms for ad hoc networks.

## III. Evaluation Metrics For Qos Routing Protocols

As different applications have different requirements, the services required by them and the associated QoS parameters differ from application to application [16]. For example, in case of multimedia applications, bandwidth, delay and delay-jitter are the key QoS parameters, whereas military applications have stringent security requirements. The following is a sample of the metrics[23] commonly used by applications to specify QoS requirement to the routing protocol.

- **Responsiveness** One of the most important user experiences in networking applications is the perception of responsiveness .if end-users feel that an application is slow; it is often the case that it is slow to respond to them, rather than being directly related to network speed.
- **Capacity and throughput** An important user metric, in the case of network applications that rely on bulk transfer, is capacity. In the past, many applications were hindered by the lack of available high-bandwidth connections. A quantitative measurement term for this experience is "throughput" defined as the rate at which a computer or network sends or receives data.
- **One-way Delay (OWD)** One-way delay is the time it takes for a packet to reach its destination. it considered a property of network links or paths.
- **Propagation Delay** Propagation delay is the duration of time for signals to move for signals to move from the transmitting to the receiving end of a link
- **Serialization Delay** Serialization delay is the time it takes for a packet to be separated into sequential link transmission units (typically bits).
- **Round-Trip Time (RTT**) The round-trip delay time (RTD) or round-trip time (RTT) is the length of time it takes for a signal to be sent plus the length of time it takes for an acknowledgment of that signal to be received.
- **Delay Variation (Jitter)** Jitter is the undesired deviation from true periodicity of an assumed periodic signal in electronics and telecommunications, often in relation to a reference clock source. Jitter may be observed in characteristics such as the frequency of successive pulses, the signal amplitude, or phase of periodic signals.
- **Maximum Transmission Unit (MTU)** In computer networking, the **maximum transmission unit (MTU)** of a communications protocol of a layer is the size (in bytes) of the largest protocol data unit that the layer can pass onwards.
- **Bandwidth Delay Product (BDP) Bandwidth-delay product** refers to the product of a data link's capacity (in bits per second) and its end-to-end delay (in seconds). The result, an amount of data measured in bits (or bytes), is equivalent to the maximum amount of data on the network circuit at any given time, i.e. data that has been transmitted but not yet received.

## IV Related Work

Routing protocols belonging to different QoS philosophies have been proposed in the literature. A fairly comprehensive overview of the state of the field of QoS in networking was provided by Chen in 1999 [4]. The conclusions highlighted several significant points in MANET research. It includes admission control policies and protocols, QoS robustness and QoS preservation under failure conditions. Researchers have come up with various routing schemes,few of them have been explored below:

**4.1 Priority-based QoS** - Authors[16] have proposed a scheme for supporting priority-based QoS in mobile ad hoc networks by classifying the traffic flows in the network into different priority classes, and giving different treatment to the flow-rates belonging to different classes. They have adopted a control-theoretic approach to adaptively control the low-priority flows so as to maintain the high priority flow-rates at their desired level, thus guaranteeing QoS to high-priority flow.

**4.2 QoS Routing** - Protocol [11] provided a very comprehensive and in depth survey about the QoS of routing in MANETs. It discussed about the QoS routing metrics, protocols, the factors that affect the performance of protocols, created the classification of protocols. The conclusions focus on several things as follows: The design of protocol is classified based on MAC, The optimization of route discovery, Reliability protocol, Management session, Measurement of performance indicators.

**4.3 SQ-AODV** - SQ-AODV [28] propose a novel energy aware stability based routing protocol for enhanced QOS in wireless ad-hoc networks, MILCOM 2008 a cross layering approach to exchange information about the residual energy in nodes to perform quality of service.

**4.4 LRAODV** - LRAODV[30] presented the approach which consists of an algorithm that enables packet forwarding misbehavior and Loss Reduction(LRAODV0 based detection through the principle of conservation of flow on the routing protocol group nodes.

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**4.5 DRAODV** - A Dynamic Reverse Route AODV (DR-AODV)[31] to supplement AODV's basic operations when dealing with unidirectional links. This scheme computes routing paths with the lowest delay and provides alternatives if the primary reverse route is blocked by a unidirectional link.

**4.6 Improved AODV -** Authors[14] proposed improved AODV routing protocol for reset a new shortest routing path during sending packet. Improved AODV routing protocol maintains expire time that created first. So expire time in routing table is not updating until expire time. Therefore, routing table updated in a cycle. Improved routing protocol ensures shortest routing path through fixed expire time. So the source packet sends to destination quickly than original AODV routing protocol.

**4.7 Multi Objective AODV** - Multi Objective AODV[10] based on realistic model. In their simulation research, they find new algorithm which find the optimum path for mobile ad hoc node. Their algorithm considered realistic movements and environments like facing obstacle or pathway. The proposed protocol considers not only hop count but also other objectives, such as mobility model, mobile node specification and routing algorithm. By considering these multi objectives, the protocol can find the best paths. In their proposed protocol, the selection of object that participates in finding path is optional. If a node lacks of facilities such as GPS, objectives which need GPS cannot be considered.

*Table 1. Comparison of various QoS Aware Protocols*

| Routing protocol | Network architecture | Type of QoS guarantee | Resource reservation | QoS metrics |
|---|---|---|---|---|
| SQ-AODV | Hierarchical | Soft | Yes | Bandwidth |
| LRAODV | Hierarchical | Soft | Yes | Bandwidth |
| DRAODV | Hierarchical | Soft | Yes | Bounded delay, packet loss rate |
| Improved AODV | Location prediction | Soft | No | Delay, and Bandwidth |
| Multi Objective AODV | Hierarchical | Pseudo-hard | Yes | Bandwidth, Delay, Delay-jitter and cost |
| EM-AODV | Hierarchical | Soft | Yes | Throughput and Delay |
| CPC-AODV | Flat | Soft | Yes | Bandwidth, Delay |
| QoS- AODV | Flat | Soft | Yes | Bandwidth, Delay |

**4.8 EM-AODV** Energy Multipath AODV (EM-AODV)[33] ,a new adaptive approach which considers the metric "residual energy of nodes" instead of the number of hops in the process route selection. In this we define the rate of energy consumption for each node to estimate its lifetime and as well define a cost that fits this lifetime and the energy level. This information is used for calculating the cost of routes and the path with minimum cost is selected. EM-AODV improves the performance of AODV in most metrics, as the packet delivery ratio, end to end delay, and energy consumption.

**4.9 CPC-AODV** -A new version of AODV[19] an on-demand routing algorithm based on cross-layer power control termed as called CPC-AODV (Cross-layer Power Control Ad hoc On demand Distance Vector) taking account of the geographic location of nodes, the energy of packet transmission

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**4.10. MRAODV** – Authors [24]proposed Modified Reverse AODV (MRAODV) stability estimation method is used for route selection and to increase performance. In the proposed routing algorithm, when a source node wants to communicate with a destination node, first it broadcasts a RREQ packet. This stage is like that of AODV algorithm. When destination receives a RREQ message, it broadcasts R-RREQ message to find source node. Each intermediate node which receives the R-RREQ message, calculates its route stability for each route using equation given below and this stability is used for selecting the path.

**4.11 QoS- AODV-** A new QoS-aware routing protocol based on AODV[34] named QAODV (QoS- AODV) is further proposed. QAODV makes the following modification: It can exclude some nodes unfit to the QoS requirements before establishing the route and reduce invalid transmission of RREQ and save the overhead in the routing establishment process. It comprehensively considers bandwidth, delay, the number of hops and congestion situation of nodes in selecting route, so it is more useful to on-time services than AODV. It utilizes virtual carrier sense via NAV to be aware of busy and free states of nodes in transmission channel to compute their available bandwidths through cross-layer design. To facilitate a comparison among the different QoS-aware routing protocols, the salient features of the QoS routing protocols is described in table1. The table lists the design constraints listed earlier such as Route discovery, Resource reservation, Route maintenance, QoS metrics constrained, Network architecture and routing overhead and discussing how each protocol addresses.

The different protocols discussed in the paper are very effective and useful for new researchers to identify new topics for further research. Several important research issues and open questions need to be addressed, it includes discovering path which is free from or has minimum number of malicious node by incorporating behaviour history of member nodes and incorporate measures like the throughput, response time, queuing delay, network link.

## V. Methodology

The proposed algorithm will be tested in simulation experiments. In the simulation environments, all nodes communicate using the IEEE 802.11 medium access protocol The mobility model we will be used in each node independently chooses a random starting point and waits there for a duration called the pause time. All nodes shall be distributed in the area and change their directions and speeds randomly. The network topology configuration file will contain following information to start a simulation and will be designed in a format of Tcl script. Each node will independently repeat the movement pattern through the simulation. The mobility and traffic model for the mobile nodes will be generated with following settings:

| Name | Description | Sample Values |
|---|---|---|
| **NODES** | The number of nodes that will exist in the simulation | 100-1000 |
| **TRANSMISSION RANGE** | The area in meters around the nodes that they will be able to communicate | 10-15 |
| **IDLE POWER** | The amount of power for a node to consume when it is not transmitting | 0.5-0.8 |
| **TRANSMIT POWER** | The amount of power for a node to consume when it is transmitting | 5.0-10.0 |
| **TRANSFER RATE** | The number of bits per second to transfer. | 10000-100000 |
| **SPEED** | A random seed to ensure that simulation with different algorithms | 50-100 |
| **AREA** | The square area (meters) of the simulation in which nodes can be contained | 1000.0-10000.0 |
| **PACKET SIZE** | The size of the packets in bits. | 8-16 |
| **COMMUNICATION PARAMETERS** | 0 for random<br>1 for fixed | 0,1 |

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Our approach will rely on modifications of AODV protocol, on which will achieve path discovering process which is free from or has minimum number of malicious node by incorporating behaviour history of member nodes and utilize the node's reservable bandwidth and load information to distribute the network loads, which can prevent network from getting into the state of congestion. The expected simulations will achieve better performance and efficiency of network in the packet delivery ratio, packet loss and average delay compared with AODV.

## VI. Conclusion

In this paper, we have presented a survey of QoS aware routing protocols for mobile adhoc networks. A lot of research has been done in this field. However the different protocols discussed in the paper are very effective and useful for new researchers to identify topics for further research. Several important research issues and open questions need to be addressed, it includes discovering path which is free from or has minimum number of malicious node by incorporating behaviour history of member nodes and incorporate measures like the throughput, response time, queuing delay, network link.

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