# Improvement in Routing to Assure Quality of Services in Manet

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***Abstract*** **A Mobile Adhoc Networks (MANETs) differs from a direct connection network in the way that it is multi-hopping and self-organizing and thus able to operate without the help of prefixed infrastructures. In addition, Quality of Service (QoS) provision is required to support the rapid growth of video in mobile traffic. The Optimized Link State Routing (OLSR) is a table-driven and proactive routing protocol that was designed for mobile ad hoc network. OLSR protocol is an optimization of the pure link state algorithm. The key concept used in the protocol is that of MultiPoint Relays (MPRs) which are selected nodes that forward broadcast messages during the flooding process. This technique substantially reduces themessage overhead as compared to a pure flooding mechanism where every node retransmits messages throughout the network. In this proposed work, I will try to incorporate QoS in OLSR routing protocol. I am going to present a novel algorithm for OLSR protocol which will enhance QoS for OLSR routing protocol. Finally, I will develop QoS versions of the OLSR routing protocol in NS2.**

***Index Terms*— Adhoc network, Qos, Ns2, Manet.**

## I. INTRODUCTION

### 1.1 Overview of Mobile Ad Hoc Networks

An ad hoc network is a collection of computers (nodes) that cooperate to forward packets for each other over a multihop wireless network. Users of such networks may wish to use demanding applications such as videoconferencing, Voice over IP, and streaming media when they are connected through an ad hoc network. Because over provisioning, a common technique in wired networks, is often impractical in wireless networks for reasons such as power, cost, and government regulation, Quality of Service (QoS) routing is even more important in wireless networks than in wired networks[1]. A group of wireless nodes which is capable of developing a network without using existing network infrastructure is known as the mobile ad hoc network. When the node wishes to forward packets with each other, it communicates with other nodes by multi - hop. Since the host mobility can cause recurrent impulsive topo logy changes, the design of a Quality of Service (QoS) routing protocol is quite complicated compared to the conventional networks [2].

Wireless ad-hoc networks have gained a lot of importance in wireless communications. Wireless communication is established by nodes acting as routers and transferring packets from one to another in ad-hoc networks. Routing in these networks is highly complex due to moving nodes and hence many protocols have been developed. In this paper we have selected three main and highly proffered routing protocols for analysis of their performance.[3] Figure1 below represents the scenario of MANET.

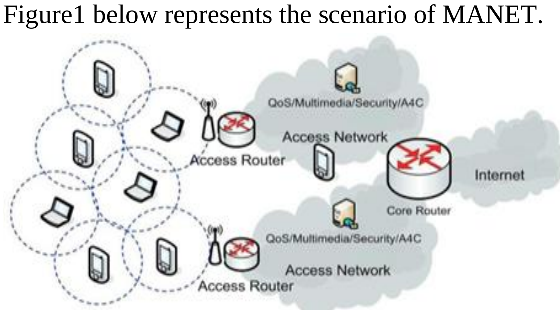
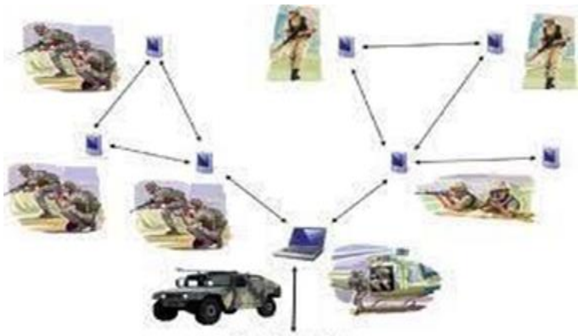



Figure 1. Ad-hoc network architecture [3]




1.2 Mobile Ad Hoc Networks' Usages

With the increase of portable devices as well as progress in wireless communication, ad hoc networking is gaining importance with the increasing number of widespread applications. Figure2 below represents an application scenario of MANET. Typical applications include [4]:

- Military battlefield. Military equipment now routinely contains somesort of computer equipment. Ad hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, andmilitary information head quarters. The basic techniques of ad hocnetwork came from this field.
- Commercial sector. Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire, flood, or earthquake.

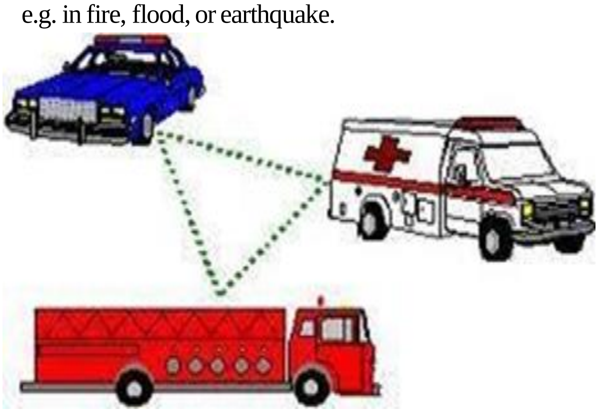


Figure 2. Applications of Manet [3]

Local level. Ad hoc networks can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at a e.g. Conference or classroom.

Personal Area Network (PAN). Short-range MAN ET can simplifythe intercommunication between various mobile devices (such as a PDA, a laptop, and a cellular phone). Tedious wired cables arereplaced with wireless connection.

## II. LITERATURE SURVEY

2.1 Mobile Ad Hoc Networks' Challenges

MANETs have several major characteristics and challenges. They are as follows [3]:

2.1.1 Limited wireless transmission range: In wireless networks the radio band willbe limited and hence data rates it can offer are much lesser than what a wired network can offer.

2.1.2 Routing Overhead: In wireless ad hoc networks, nodes often change their location within network. So, some stale routes are generated in the routingtable which leads to unnecessary routing overhead.

2.1.3 Battery constraints: This is one of the limited resources that form a majorconstraint for the nodes in an ad hoc network. Devices used in these networkshave restrictions on the power source in order to maintain portability, size andweight of the device.

2.1.4 Asymmetric links: Most of the wired networks rely on the symmetric linkswhich are always fixed. But this is not a case with ad hoc networks as thenodes are mobile and constantly changing their position within network.

2.1.5 Time-varying wireless link characteristics: The wireless channel is susceptible to a variety of transmission impediments such as path loss, fading, interference and blockage.

2.1.6 Broadcast nature of the wireless medium: The broadcast nature of the radio channel, that is, transmissions made by a node are received by all nodes within its direct transmission range.

When a node is receiving data, no other node in its neighborhood, apart from the sender, should transmit.

2.1.7 Packet losses due to transmission errors: Ad hoc wireless networks experiences a much higher packet loss due to factors such as high bit error rate(BER) in the wireless channel.

2.1.8 Mobility- induced route changes: The network topology in an ad hoc wirelessnetwork is highly dynamic due to the movement of nodes; hence an on-goingsession suffers frequent path breaks. This situation often leads to frequentroute changes.

2.1.9 Potentially frequent network partitions: The randomly moving nodes in an adhoc network can lead to network partitions. In major cases, the intermediate nodes are the one which are highly affected by this partitioning.

2.2 A Survey of Routing Protocols that Support QoS in Mobile Ad Hoc Networks, *by Lei Chen and Wendi B. Heinzelman, IEEE Network, Nov/Dec 2007* [9]

The explosive growth in the use of mobile devices coupled with users' desires forreal-time applications has provided new challenges in the design of protocols for mobile adhoc networks. Chief among these challenges to enabling real-time applications for mobile ad hoc networks is incorporating support for quality of service (QoS), such as meeting bandwidth or delay constraints. In particular, it is important that routing protocols incorporate QoS metrics in route finding and maintenance to support end-to-end QoS. This article extensively and exclusively presented the issues involved with QoS-aware routing and an overview and comparison of existing QoS-aware routing protocols. In addition, the open issues that must be addressed to fully support QoS-aware routing are discussed.

MANET routing protocols like CEDAR, Ticket-based, OLSR-based, AQOR, ADQR, TDR, BEQ R are discussed and compared. Comparison of these routingprotocols are made in basis of several parameters like QoS metric, bandwidth/delay estimation, route discovery, resource reservation, route break prediction and redundant routes.

All above mentioned protocols are also compared in terms of mobility support, Routing overhead and network architecture.

There are also some open issues discussed in QoS aware routing like bandwidth/delayestimation, route discovery, route maintenance, resource reservation and cross layer design.

After the careful study of this paper we conclude the following points:

1. OLSR-based QoS-aware routing protocol looks more promising than other routingprotocols for QoS provisioning.

2.The attractive features of OLS R-based QoS-aware routing are proactive by nature; it does bandwidth estimation, no other additional requirement etc.

3. It has still some open issues which can be worked for future like MP R setSetup, selfish nature of MPR nodes, delay estimation is missing etc.

4. So, these open issues have attracted me to work on OLSR-based routing Protocol for QoS-provisioning in routing.

2.3 Quality of Service Routing in a MANET with OLSR, *by Dang-Quan Nguyen, Pascale Minet, Journal of Universal Computer Science, vol. 13, no. 1 (2007), 56-86* [10]

Ad hoc wireless networks have enormous commercial and military potential because of their self-organizing capacity and mobility support. However, some specificity ofthese networks such as radio interferences and limited resources make more complexthe quality of service (QoS) support. Indeed, on the one hand, the bandwidth offeredto users is strongly affected by radio interferences. On the other hand, flooding information in such a network must be optimized in order to save resources. Therefore, authors have proposed a solution taking into account radio interferences in mobile ad hoc network routing and optimizing flooding. This solution is based on a modified version of the O LSR routing protocol that considers bandwidth requests and radio interferences in the route selection process while providing a very efficient flooding. A comparative performance evaluation based on NS simulations shown thatdespite the overhead due to QoS management, this solution outperforms classicalOLSR in terms of QoS perceived by the users (e.g. bandwidth a mount granted to a flow and delivery rate). The efficiency of the optimized flooding is equal to that provided by the native version of OLSR.

As in a wired network, QoS support in a MAN ET is required by more and more applications. Authors assumed here that an application expresses the QoS it requires in terms of bandwidth. As radio interferences strongly affect the bandwidth offered tousers, they must be taken into account in the bandwidth management. As QoS supportimplies to select MP Rs according to their local available bandwidth, it leads to anumber of MP Rs per node higher than that obtained with the native version of OLS
R. Consequently, the efficiency of flooding is reduced. In this paper, authors haveshown how to reconcile an interference-aware QoS support with an efficient flooding. This solution distinguishes two types of multipoint relays: those in charge of MP R flooding that are selected as specified in the classical OLS R version and the othersthat are used to select routes, considering bandwidth demand and interferences. Simulation results have shown that with the proposed solution, routes are more stable and accepted flows receive the bandwidth they have requested. Moreover, the overhead. Due to this QoS support, is kept low and flooding achieves the excellentperformances as in the native version of OLSR.

After the careful study of this paper, we conclude the following points:

1. Bandwidth calculation is not done. It is assumed that each node knows the bandwidth of communication link which is very difficult to find.
2. Delay estimation is not considered in this paper.
3. Cross layer design is used which is very much challenging and difficult toImplement.

2.4 Reputation-Based Cooperative Detection Model of Selfish Nodes in Cluster-Based QoS-OLSR Protocol, *by Nadia Moati, Hadi Otrok, Azzam Mourad, Wireless Pers Commun, Springer Science, Business Media, New York, 2013* [12]

The QOLSR is a multimedia protocol that was designed on top of the optimized link state routing (OLSR) protocol for mobile ad hoc netwok. It considers the quality ofservice (QoS) of the nodes during the selection of the multi-point relay (MPRs) nodes.One of the drawbacks of this protocol is the presence of selfish nodes that degrade thenetwork lifetime. The limited energy and resources, and the absence of any motivation mechanism cause mobile nodes to behave selfishly during the MP Rs selection. A new MP R selection based on cluster head election was proposed inprevious work to increase network lifetime. In this paper, authors considered the selfishness during the election and selection process by proposing the use of reputation system that will motivate nodes to participate during the selection of MPRs, where the reputation is calculated based on VCG mechanism design. After solving the selfishness during network formation, authors have discovered that nodes can misbehave after being selected/elected. Such a passive malicious behavior couldlead to a denial of service attack due to the drop of packets. As a solution, authorsproposed a hierarchal cooperative watchdog detection model for the cluster-basedQOLSR, where nodes cooperate in a hierarchical manner to detect selfish nodes.Moreover, to motivate watchdogs to monitor and cooperate with each other, incentives are given and calculated using cooperative game theory, where Shapleyvalue is used to compute the contribution of each watchdog on the final decision. Simulation results shown that the novel cluster-based QoS-OLSR model can giveincentive to nodes to behave normally without sacrificing the quality of service of thenetwork. In addition, the hierarchical cooperative detection model shows a morereliable and efficient detection of selfish nodes.

4. The scarcity of energy and the difficulty of recharging in ad hoc networks made selfish nodes a common problem during and after selection of MPR nodes in a cluster-based QOLSR network. The results show that if 50%of the nodes are selfish, the packet delivery percentage drops to 10%. All experimental results are done on themobile cluster-based QOLS R models. Authors have presented a novel efficient motivation and detection model that (1) motivates nodes during selection to behavenormally by increasing their reputation then consider it when selecting MP R nodes and (2) detects nodes behaving selfishly after selection basing the final decision of thedetection on a weighted decision where the most trusted node has the leading contribution. Incentives are granted to watchdogs based on their final contribution andcalculated based on Shapley value.

After the careful study of this paper we conclude the following points:

5. Results show that including reputation as one of the QoS metric does not affect the performance and quality of service QoS of the network, whereas it makes the networkmore reliable and trustworthy. So by including proposed mechanism we cannot have any enhancement in terms of performance or QoS of the network. It just makes thenetwork more reliable and trustworthy.
6. As a future work we can consider a punishment system that will punish detected selfish nodes and malicious watchdog nodes that give false detection as it was missing incurrent proposed mechanism

## III.PROPOSED METHODOLOGY

Optimized Link State Routing (OLSR) protocol

OLSR (Optimized Link State Routing), [Adjih et al. 2003], is an optimization of apure link state routing protocol. It is based on the concept of multipoint relays (MPRs). F irst, using multipoint relays reduces the size of the control messages: rather than declaring all its links to all nodes in the network, a node declares only the setof links with its neighbors that have selected it as “multipoint relay”. The use of MPRs also minimizes flooding of control traffic. [10] OLS R protocol inherits the stability of link state algorithm. The optimization in the routing is done mainly in twoways. Firstly, OLSR reduces the size of the control packets for a particular node by declaring only a subset of links with the node's neighbors who are its multipointrelay selectors, instead of all links in the network. Secondly, it minimizes flooding of the control traffic by using only the selected nodes, called multipoint relays to disseminate information in the network. As only multipoint relays of a node canretransmit its broadcast messages, this protocol significantly reduces the number ofretransmissions in a flooding or broadcast procedure. [6] Each node in the networkkeeps a routing table. This makes the routing overhead of OLSR higher than any otherreactive routing protocol such as AODV or DS R. However, the routing overhead does not increase with the number of routes in use since there is no need to build anew route when needed. This reduces the route discovery delay. [15] The Optimized Link State Routing (O LSR) protocol to find a route with larger bandwidth (OLS R- based). This approach does not modify the routing scheme of O LSR, but it chooses different criteria that incorporate bandwidth into consideration to select the multipoint relay (MPR) set so as to find a larger bandwidth route. Route maintenance and resource reservation are not considered in this protocol. [9]

Table 1. Comparison of QoS-aware routing protocol performance.

| Routing protocol | Mobility support | Routing overhead | Additional requirement | Network architecture |
|---|---|---|---|---|
| CEDAR | Medium<br>• Cached routes via Cores | • Core setup<br>• Proactive broadcasting oflink state information among cores | No | Hierarchical |
| Ticket-based | High<br>• Secondary path<br>• Local route repair | • Limited flooding of RREQ | No | Flat |
| OLS R-based | Low | • MPR set setup<br>• Proactive broadcasting ofrouting packetsamon MPRs<br>• Limited flooding of RREQ | No | Hierarchical |

MPR selection is the key point in OLS R. The smaller the MPR set is, the less overhead the protocol introduces. The proposed heuristic in for MPR selection is toiteratively select a 1-hop neighbor which reaches the maximum number of uncovered 2-hop neighbors as MPR. [14] If there is a tie, the one with higher degree (more neighbors) is chosen. Table 2 shows how node B selects MPR(s), based on the network depicted in Figure 3:

Table 2: MPR selection in OLSR

| Nodes | 1 hop Neighbors | 2 hop Neighbors | MPR(s) |
|---|---|---|---|
| B | A, C, F, G | D, E | C |

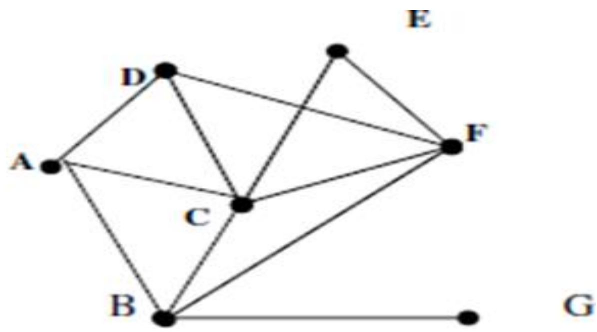



Figure 3. Network example for MPR Selection

An example of how this algorithm works is shown below based on the network depicted in Figure 3: From the perspective of node B, both C and F cover all of node B's 2-hop neighbors.However, C is selected as B's MP R as it has 5 neighbors while F only has 4 (C's degree is higher than F).

Limitations of OLSR in QoS Routing

As mentioned, OLS R is a routing protocol for best-effort traffic, with emphasis on how to reduce the overhead, and at the same time, provide a minimum hop route. So, in its MP R selection, the node selects the neighbor that covers the most unreached 2-hop neighbors as MPR. [14] This strategy limits the number of MPRs in the network, ensures that the overhead is as low as possible. However, in QoS routing, by such an MPR selection mechanism, the "good quality" links may be "hidden" to other nodesin the network. As an example, we will consider the network topology in Previous again (see Figure 4.) The numbers along the lines indicate the available bandwidth over the links. As explained earlier, in the O LSR MP R selection algorithm, node Bwill select C as its MPR. So for all the other nodes, they only know that they canreach B via C. Obviously, when D is building its routing table, for destination B, it will select the route D-C-B, whose bottleneck bandwidth is 3, the worst among all the possible routes.

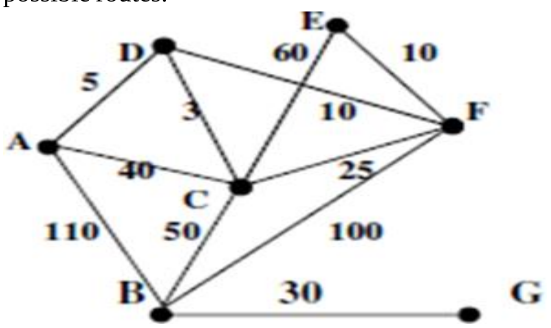



Figure 4. Bandwidth-QoS Network Example for MPR Selection

Also, when "bandwidth" is considered to be the QoS constraint, in building the routing tables, nodes can no longer use the "Shortest Hops Path" algorithm, as the path with the minimum hops may not be the path with best bandwidth.

## IV. CHANGING THE MPR SELECTION CRITERIA

The decision of how each node selects its MPRs is essential to determining the optimal bandwidth route in the network. In the MP R selection, a "good bandwidth" link should not be omitted. In other words, as many nodes as possible that have high bandwidth links connecting to the MP R selector must be included into the MPR sets. Based on this idea, several revised MPR selection algorithms are presented in literature.[14]

Routing Table Calculation

Besides the MP R selection method, a node also needs to change the "Shortest Hops Path" algorithm in its routing table computation to reflect the bandwidth as the QoS metric.

Proposed QoS OLSR protocol

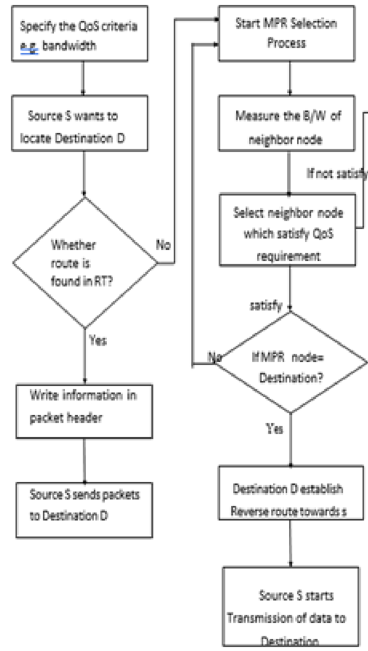



Figure 4: flow chart of proposed QoS mechanism in OLSR protocol

Here, algorithms are found in literature. One is the "maximum bandwidthspanning tree".[14]

## V.Simulation Environment Result

| Parameters | DSDV | | | OLSR | | | QoSOLSR | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 | 15 | 20 | 10 | 15 | 20 | 10 | 15 | 20 |
| Send packets | 304 | 459 | 614 | 303 | 446 | 611 | 301 | 438 | 607 |
| Received packets | 270 | 389 | 474 | 282 | 407 | 539 | 289 | 411 | 556 |
| Forwarded Packets | 46 | 164 | 224 | 62 | 195 | 252 | 78 | 227 | 278 |
| Dropped Packets | 33 | 61 | 134 | 1 | 1 | 0 | 0 | 0 | 0 |
| Packet Delivery Ratio | 88.20 | 84.75 | 77.20 | 93.07 | 91.26 | 88.22 | 96.01 | 93.84 | 91.60 |
| Throughput | 0.96 | 3.06 | 4.23 | 1.19 | 3.58 | 5.03 | 2.13 | 3.76 | 6.78 |
| End to End Delay | 76.54 | 93.63 | 89.09 | 98.40 | 104.2 | 100.7 | 88.54 | 101.7 | 99.36 |

Table 3: Performance of Protocol

## VI. CONCLUSION

A Mobile Adhoc Networks (MANETs) differs from a direct connection network in the way that it is multi-hopping and self-organizing and thus able to operate without the help of prefixed infrastructures. In addition, Quality of Service (QoS) provision isrequired to support the rapid growth of video in mobile traffic.

The Optimized Link State Routing (O LSR) is a table-driven and proactive routingprotocol that was designed for mobile ad hoc network. OLS R protocol is an optimization of the pure link state algorithm. The key concept used in the protocol is that of MultiPoint Relays (MP Rs) which are selected nodes that forward broadcast messages during the flooding process. This technique substantially reduces the message overhead as compared to a pure flooding mechanism where every node retransmits messages throughout the network.

OLSR is a proactive routing protocol which is best suited for QoS provisioning. So OLSR will be modified by proposed method in order to assure QoS in O LSR routing. There are several other issues of O LSR as well. E.g. MRP Setup algorithm.The proposed method will also find the best way to choose MRP nodes for QoS routing.

The proposed mechanism will be incorporated in OLSR routing protocol and will beimplemented and simulated in NS2.

6.1 Future work

- Other routing information like received power and distance can be exploited forOLSR MPR selection and can be used for routing decisions.
- Proposed algorithm can be implemented on other routing protocols like AODV,DSR, DSDV, TORA etc. by implementing MPR.
- Proposed algorithm can be also simulated for Wireless Sensor Network (WSN).

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