Comparatively study of proactive protocols for MANET

Saleha Siddiqui
Electronics Section, University Polytechnic,
F/O Engineering & Technology, JMI, Delhi.

Abstract

As the interest goes on in the MANET, particularly for the requirement of dense deployment, the network is supposed to be more reliable in terms of good services. In a few years from now, we will notice a broader range of wireless devices accessing the Internet in many areas. Use of the routing protocols in maintaining and establishing ad-hoc networks is one of the most liking research topics in MANET. Scalability, minimum control overhead, distributed routing approach, loop free routing and quick routing reconfiguration are the main requirements that should be met by any routing protocol. In this paper we reviewed various protocols for manet and analyzed their performance.

Keywords: Mobile Ad hoc Network (MANET), Protocol, AODV, DSR, Throughput etc.

1. Introduction

Over the past few years, as the dramatically increased in popularity and usage of wireless networks and inexpensive widely available mobile devices (smart phones, laptops, sensors based intelligent gadgets, virtual cameras, digital portable equips etc.), MANET has emerged one of the utmost exciting and active subjects of wireless network and communication. This kind of wired free network, behaves like a stand-alone network. It can operate with one and with several end points of connection to cellular networks or Internet, which further paves the way for various exciting and useful applications [1].

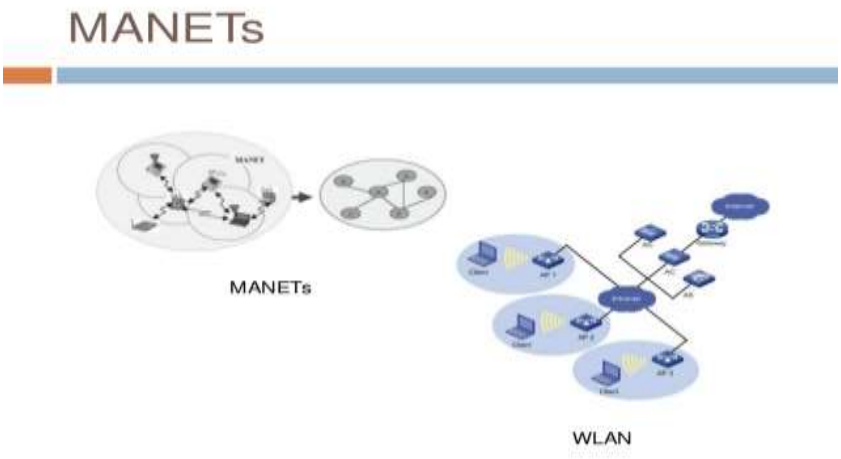

Figure 1: Typical MANET

As MANET consisting of thousand nodes is able to support a regiment by providing precious information without the help of any manual network setup that often comes from 'switchboard'-era communications. It helps troops to make them available with some convenient and stout services for instance real time video imagery, enhanced situational awareness and other services that we have not yet imagined [2]. Making it much more

informative and significant, the future's battlefields are becoming smartly networked and connected like never before. These advancements are actually supported by huge advances in MANET in the civil and public safety sectors, which currently provide major advantages over typical tactical military communications systems. In this advanced information arena, we are able to receive high-bandwidth deliberated information from satellites, intelligent devices, robots, helmet-mounted cameras, intelligence-based equipment, drones, night vision devices, airplanes, situational awareness sensors, an arsenal of sensors and more.

2. Background of research

We have reviewed various queueing model in the literature and investigated how the how the various proactive and reactive protocols are used for measuring various parameters. Authors proposed to improve the route discovery process of AODV by the addition of the two parameters of residual battery power and buffer size [3]. It was done via the addition of an Energy and Delay-Constrained (EDC) algorithm. Current size of the queue is controlled to restrict end-to-end delay of the data packets. In [4, 5], the authors presented an on-demand routing protocol, named Split Multi-path Routing (SMR), which calculates two paths in route discovery. The authors proposed a new multi-path routing algorithm that selects zone-disjoint paths, using omni-directional antenna. The strategy of Multipath selection and Delay has been proposed to improve end-to-end delay and to minimize packet loss.

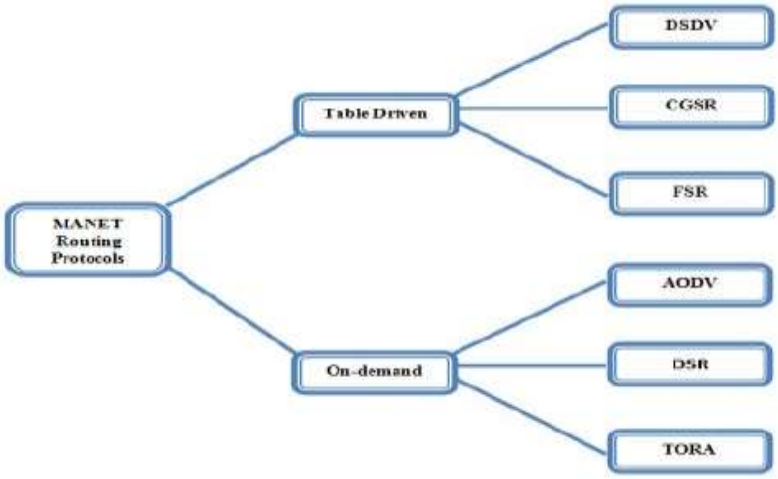

Figure 2: Typical categorization of protocols

Many delay aware extensions have been proposed to earlier routing protocols like AODV, DSR and OLSR to make them QOS capable. Designing of cross layer architecture and stochastic models left amuse many academician and developer to produces better outcomes although on unfair resources. Researchers are studying MANETs to measure their performances in different scenarios, analyzing and improving them. If simulation and modeling is useful in capturing real world scenario and to study any systems [6].

In [7, 8], the authors applied certain modification to AODV to mitigate the delay issues present in AODV, simultaneously ensuring optimal utilization of battery power. Their approach was based on the received Log Likelihood Ratios (LLR) on the basis of which the intermediate hosts decide whether to take part in the transmission or not, hence the nodes that decide not to communicate saves quite a considerable amount of energy. Also, the nodes function at high transmission range if the traffic is real time in nature; as a result, end to end delay is greatly reduced due to decrease in number of intermediate nodes.

Properties	DV	WRP	DSR	AODV
Type of routing	Proactive	Proactive	Reactive	Reactive
Distributed	YES (hop-by-hop)	YES (hop-by-hop)	NO (source routing)	YES (hop-by-hop)
Routing loops	Possible	Not Possible	Not Possible	Not Possible
Use of broadcast	No	No	Yes	Yes
Control Overhead	Constant to the number of sessions	Constant to the number of sessions	Affected by the number of sessions	Affected by the number of session
Routing entries	All destinations	All destinations	Destinations in use	Destinations in us
Alternative paths	Not available	Not available	Available	Available
Request response	Short	Short	Long (if not cached)	Long (if not cache
Advantages	Short response time Low message OH	Short response time	Quick path recovery	Small routing tabl Quick recovery
Disadvantages	Routing loops Large routing table Long convergence time	Large routing table	Long response time Large packet header	Long response tim Aggregate routing not possible at intermediate node

Table 2: Characteristic of some typical proactive protocols

A QoS aware routing with some improved extensions helps in choosing optimal path from source to destination using hop count as a basis along with delay and bandwidth. Although, the protocol does not consider the intrinsic dynamics of the network, such as varying topology because of movable nodes going out of range, which results link failure or the occurrence of node failure, which in turn leads to inaccurate delay estimates. A new routing protocol, namely, Delay Aware AODV Multi-path (DAAM) has been projected in [9]. This protocol enables the computation of multiple node-disjoint paths without incurring the overhead generated by link-state routing methods. The cumulative delay during the route discovery process from the source node to destination node is recorded by each node.

In [10, 11], the author discussed EDAODV protocol which is an improved form of AODV, adding in it energy and delay extensions. These two extra constraints of low energy and high delay are added to the AODV routing table per entry. Therefore, the MN sends a route request (RREQ) packet containing the extension of QoS energy and delay in the network. Further, the additional method developed for AODV was applied to DSR. The very famous route discovery process in DSR practices these energy and delay extensions and results a new protocol is called EDDSR. Ad hoc QoS on-demand routing (AQOR) [12] incorporated restricted flooding to search the better link possible in terms of minimum end-to-end delay. A route request packet includes both end-to-end delay and bandwidth constraint. Delay is computed during route discovery. The route with least delay is selected by source.

The authors have developed a QOS aware routing approach for MANETs based on DSR that focused on two metrics: energy and delay [13]. They named their approach as DSR_ED. They introduced some new fields in packet formats of RREQ, RREP and RERR messages. These new fields are specific to the two metrics used. This method claims enhanced timeliness and efficient utilization of energy by avoiding nodes that are busy and low on battery power. This concept makes routing decisions based on residual energy levels of the nodes. Hence, this proposed method (DSR_ED) uses the network resources optimally, decreases latency and prolongs network lifetime.

Various authors [14] have designed an energy aware and delay aware routing protocol by adopting a time delay function in flooding RREQ packets. This function varies inversely with the remainder battery power of the intermediate nodes. They named their proposal as Time Delay On-demand Multipath routing protocol (TIDOM).

TIDOM is an extension to AODV. The time delay function promotes nodes having good battery backup and avoids those nodes having poor residual battery power. Authors have proved through Qualnet simulations that TIDOM is capable of conserving battery capacity of the constituent nodes, increasing packet delivery ratio, decreasing overheads, increasing lifetime of links and hence, increasing lifetime of the network as a whole.

The authors introduced a new routing protocol which they named as LDAR (Link Delay Aware Routing) [15]. LDAR is based on a new metric that takes into consideration the various kinds of delay experienced by the link, namely, processing delay, queuing delay and transmission delay. The proposed metric for link delay avoids any additional network overhead and supports varying link rates. LDAR protocol is based on commodity (Linux) TCP/IP stack. A MANET testbed consisting of 5 laptop nodes was used to implement the proposed protocol along with the simulator being NS-2 as shown in figure 3.

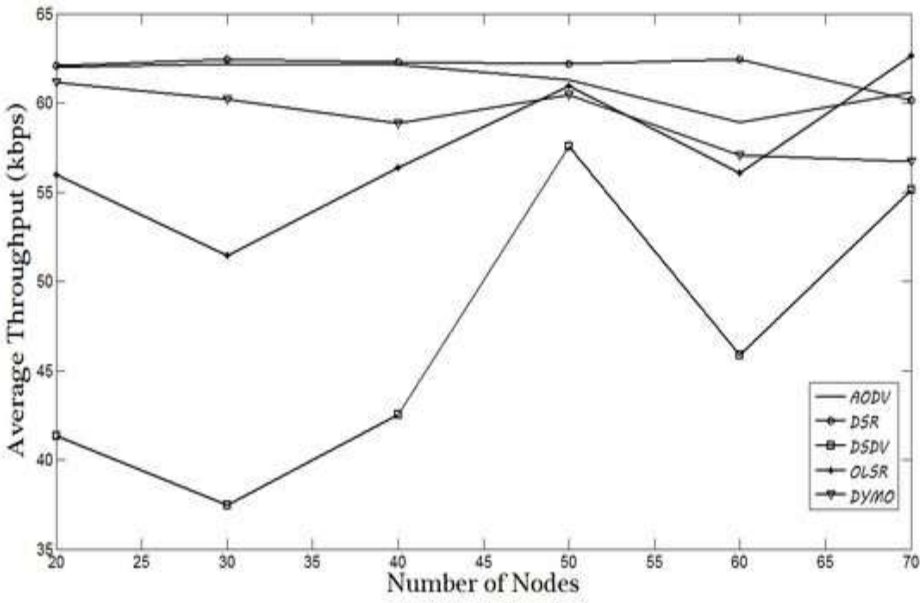

Figure 3: Graph between Number of Nodes and Average Throughput

A QoS aware routing with some improved extensions helps in choosing optimal path from source to destination using hop count as a basis along with delay and bandwidth. Although, the protocol does not consider the intrinsic dynamics of the network, such as varying topology because of movable nodes going out of range, which results link failure or the occurrence of node failure, which in turn leads to inaccurate delay estimates.

In [16], the author discussed EDAODV protocol which is an improved form of AODV, adding in it energy and delay extensions. These two extra constraints of low energy and high delay are added to the AODV routing table per entry. Therefore, the MN sends a route request (RREQ) packet containing the extension of QoS energy and delay in the network. Further, the additional method developed for AODV was applied to DSR. The very famous route discovery process in DSR practices these energy and delay extensions and results a new protocol is called EDDSR. Ad hoc QoS on-demand routing (AQOR) [17] incorporated restricted flooding to search the better link possible in terms of minimum end-to-end delay. A route request packet includes both end-to-end delay and bandwidth constraint. Delay is computed during route discovery. The route with least delay is selected by source.

The authors have developed a QOS aware routing approach for MANETs based on DSR that focused on two metrics: energy and delay [18]. They named their approach as DSR_ED. They introduced some new fields in packet formats of RREQ, RREP and RERR messages. These new fields are specific to the two metrics used.

This method claims enhanced timeliness and efficient utilization of energy by avoiding nodes that are busy and low on battery power. This concept makes routing decisions based on residual energy levels of the nodes. Hence, this proposed method (DSR_ED) uses the network resources optimally, decreases latency and prolongs network lifetime. Various authors [19] have designed an energy aware and delay aware routing protocol by adopting a time delay function in flooding RREQ packets. This function varies inversely with the remainder battery power of the intermediate nodes.

The authors introduced a new routing protocol which they named as LDAR (Link Delay Aware Routing) [20]. LDAR is based on a new metric that takes into consideration the various kinds of delay experienced by the link, namely, processing delay, queuing delay and transmission delay. The proposed metric for link delay avoids any additional network overhead and supports varying link rates. LDAR protocol is based on commodity (Linux) TCP/IP stack. A MANET testbed consisting of 5 laptop nodes was used to implement the proposed protocol along with the simulator being NS-2.

Conclusion

The coming future will see many more efficient routing protocols which will be more concerned about the quality of service and the security. Routing was the main goal of the routing protocols proposed till date but a secured routing protocol aware of the QoS might be proposed. Considering both these parameters together will prove to be a challenge to the scientists. Computational overhead will be more in the case of a secured routing protocol which will lead to the degradation of the QoS level. Therefore, the research might just come up with a advanced routing protocol which has an optimal value between security and QoS with the support of multicasting. Multicasting is used to reduce the utilization of bandwidth in large networks.

References

1. S.K Sarkar, T.G. Basavaraju, C. Puttamadappa, Ad Hoc Mobile Wireless Networks: Principles, Protocols, and Applications, CRC Press, 2nd Edition, 16 Nov 2016.

2. C. K. Toh, Adhoc Mobile Wireless Networks: Protocols and Systems, Person, 2015.

3. L. Liu, L. Zhu, Q. Wu, Improvement of AODV Routing Protocol with QoS Support in Wireless Mesh Networks, Physics Procedia, Elsevier, Vol. 25, 2012, pp. 1133-1140, 2012.

4. Nastooh Taheri Javan, Mehdi Dehghan, Reducing End-to-End Delay in Multi-path Routing Algorithms for Mobile Ad Hoc Networks, International Conference on Mobile Ad-Hoc and Sensor Networks, Mobile Ad-Hoc and Sensor Networks, pp 715-724, 2007.

5. K. Erciyes, O. Dagdeviren, D. Cokules and Hasan Gumus, Modeling And Simulation Of Wireless Sensor And Mobile Ad Hoc Networks", Proceedings of the International Conference on Modeling and Simulation, Konya, Turkey, pp. 28-30, August 2006.

6. M. Karimi and D. Pan, "Challenges for Quality of Service (QoS) in Mobile Ad-Hoc Networks (MANETs)," in proc. 2009 IEEE 10th Annual Wireless and Microwave Teachnnolgy, 2009, Clearwater, FL, USA, pp.1-5.

7. Scalable routing protocol for ad-hoc networks. Wireless Networks, 7(5), 513-529.

8. Abolhasan, M., Wysocki, T. & Dutkiewicz, E. (2004). A review of routing protocols for mobile ad hoc networks. Ad Hoc networks, 2(1), 1-22.

9. Schaumann, J. (2002). Analysis of the zone routing protocol. Course CS765, Stevens Institute of Technology Hoboken, New Jersey, USA, 8th December.

10. Wang, L., & Olariu, S. (2004). A two-zone hybrid routing protocol for mobile ad-hoc networks. Parallel and Distributed Systems, IEEE Transactions on, 15(12), 1105-1116. 15) Woo, S. C. M., & Singh, S. (2001).

11. P. SailajaB. Ravi, Jaisingh T., Performance Analysis of AODV and EDAODV Routing Protocol Under Congestion Control in VANETs, 018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), April 2018

12. Palaniyappan Srinivasan, P. Kamalakkannan, EAQ-AODV: Route stability and energy aware QoS routing in mobile Ad Hoc networks, International Journal of Computers Communications & Control 8(6):1-5, December 2012

13. Saad M.Adam, Rosila Hasan, Delay aware Reactive Routing Protocols for QoS in MANETs: a Review, Journal of Applied Research and Technology, Volume 11, Issue 6, December 2013, Pages 844-850.

14. S. Chakrabati and A. Mishra, "QoS Issues in Ad Hoc Wireless Networks," IEEE Communication Magazine, vol. 39, Issue 2, pp. 142-148, 2001.

15. M. Malik,Shen Ting Zhi, U. Farooq, "Latency Aware Routing Mechanism to Maximize the Lifetime of MANETs" IEEE Communications Surveys & Tutorial., pp. 158–162, December 2011.

16. Bibhash Roy, Suman Banik, Nabendu Chaki, Biswajit Saha, QAODV: An AODV Based Routing Protocol for QoS Parameters, Conference: CTCS-2010, October 2010.

17. LingLiu[1]LeiZhu[1]LongLin[2]QihuiWu[1]Improvement of AODV Routing Protocol with QoS Support in Wireless Mesh Networks, Physics Procedia, Volume 25, 2012, Pages 1133-1140

18. S. Chandra P., A Survey on MANET Securing Challenges and Routing Protocols, IJCTA, Vol.4, Issue 2, pp. 248-256, 2013.

19. J.N. Boshoff, A.S.J. Helberg, "Improving QoS for real-time multimedia traffic in Adhoc Networks with delay aware multi-path routing", in WTS 2008, pp. 1, April 2008.

20. Ambika, J. NEGINAL, Energy Efficient Link-Delay Aware Routing in Wireless Sensor Networks, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 8, Issue 6, June2019, ISSN: 2278 – 1323.