Volume 4, Issue 1, January 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Improving Congestion Control for Performance Enhacemnet in MANETs

Gurpreet Singh*, Anil Manohar Dogra
Deptt. of Computer Science and Engg.,
Indo Global college of Engineering,
Mohali Punjab, India

Abstract— A Mobile Ad hoc Network (MANET) is a collection of mobile wireless nodes that can dynamically form a network without necessarily using any pre-existing infrastructure. Due to the potential ease of deployment, it is widely used in civilian & military applications. Its multihop connectivity allows the transmission range to be extended infinitely. While its intriguing features enable MANETs to be installed in many situations where traditional networks are unavailable, destroyed or impossible, they pose several problems which arise due to the shared nature of the wireless medium, limited transmission range of wireless devices, node mobility and energy constraints etc.The transmission control protocol (TCP) is one of the most popular and widely used end-to-end protocols for the Internet today. Unlike routing, where packets are relayed hop-by-hop toward their destination, TCP actually provides reliable end to-end transmission of transport-level segments from source to receiver. As TCP was designed for wired networks it considers that all packet loss in the network is due to congestion. Wireless medium is more exposed to transmission errors and sudden topological changes. So in this thesis work, we have analyzed the performance of three TCP variants on DSDV and OLSR, which were designed to improve performance in wireless networks. An ns-2 based simulation analysis of TCP Tahoe, TCP Reno, and TCP Sack and TCP Vegas on DSDV and OLSR under random early detection (RED) active queue management techniique is done. The effect of network density on the TCP variants with RED was studied. Experimental studies show that TCP vegas with RED performs better than the other variants and the performance of DSDV routing protocol under TCP-vegas much better than DSDV under TCP-vegas while RED-active queue management technique is used.

Keywords— MANETS, DSDV ,OLSR, TCP, RED, NS-2, CBR traffic

I INTRODUCTION

A wireless ad-hoc network is a decentralized type of wireless network. An ad hoc wireless network is a collection of two or more devices equipped with wireless communications and networking capability. Such devices can communicate with another node -that is immediately within their radio range or one that is outside their radio range. For the latter scenario, an intermediate node is used to relay or forward the packet from the source toward the destination. The network is ad hoc because it does not rely on a preexisting infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks. Instead, each node participates in routing by forwarding data for other nodes, and so the determination of which nodes forward data is made dynamically based on the network connectivity. An ad hoc wireless network is self-organizing and adaptive. Ad hoc devices should not only detect the presence of connectivity with neighboring devices/nodes, but also identify what type the devices are and their corresponding attributes. Since an ad hoc wireless network does not rely on any fixed network entities, the network itself is essentially infrastructure less. The task of routing in mobile ad hoc network is non trivial since host mobility and changes in node activity status cause frequent unpredictable topological changes. The simplest approach to routing in a dynamic topology would be flooding the network with a packet to be sent, with the hope that it would eventually reach the destination. However, this is extremely inefficient. Routing protocols for ad hoc networks assume a rate of topology change not high enough to make flooding the only alternative and not low enough to make conventional routing protocols effective. A routing protocol for ad hoc networks must be distributed, since in view of the dynamic topology no centralized point of control is possible. It should generate routes quickly so that they can be used before topology changes. Also, it must be bandwidth efficient, power conserving, and have minimal control overhead. The design of a routing protocol is challenging due to the unique characteristics of Adhoc network, including resource scarcity or the unreliability of the wireless medium.There are various ways to classify routing protocols. Figure 1 presents three different classifications based on the *network structure or organization, the route discovery process, and the protocol operation*.

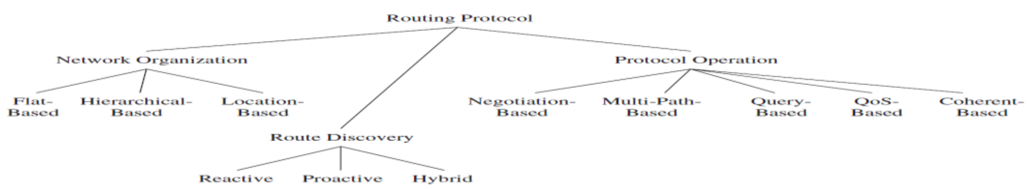

Figure 1: Categories of Routing Protocols

II. PROPOSED METHODOLOGY

In this work, TCP sender side mechanisms and appropriate queue management algorithm to handle higher offered load, random losses and retransmission timeouts in high delay networks in such a way as to keep congestion window as high as possible, while keeping the congestion under control and keep retransmissions to minimal. The TCP proposed mechanisms are assessed against TCP RENO, New RENO, TCP VEGAS and Active queue management algorithm to see how they fare against congestion and higher offered load. Ns2 simulator is selected as the simulation tool because of the ease of use of the graphical interface provided and extensive support of TCP. Also the free license availability for research purpose encouraged us to select ns2 simulator.Transport Control Protocol (TCP) is a connection oriented protocol of the transport layer. It provides features like reliability, flow control and congestion control. As TCP was designed for wired networks it considers that all packet loss in the network is due to congestion. Wireless medium is more exposed to transmission errors and sudden topological changes. So when we adapt TCP to ad hoc networks It misinterprets the packet losses due to link failure as packet losses due to congestion and in the instance of a timeout, backing-off its retransmission timeout (RTO). This results in unnecessary reduction of transmission rate because of which throughput of the whole network degrades. Due to high error rates and connectivity characteristics of wireless links, TCP reacts to packet loss as it would in wired environment. It drops the transmission window size before retransmitting packets and initiates congestion control or avoidance mechanism such as slow start and resets its transmission timer. TCP-Tahoe, TCP-Reno, TCP-New Reno, TCP Sack, TCP-Vegas and TCP- New Jersey are some of the most important variants of TCP. Depending on the scenario selection of TCP variant has to be done.

A. Simulation And Results

This simulation process considered a wireless network of various network size consisting of 40, 60, 80 and 100 nodes which are placed within a 1500m x 1500m area. FTP traffic is generated among the nodes. The simulation runs for 150 Seconds. Table I shows the important simulation parameters used in the simulation process.

B. Network Simulator – ns2

In this thesis work, network simulator (ns-2.33) is used to perform the simulation for different TCP varients with and without Random Early Detection (RED-active queue management).*ns* is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. The simulator supports a class hierarchy in C++ (also called the compiled hierarchy in this document), and a similar class hierarchy within the OTcl interpreter(also called the interpreted hierarchy in this document). The two hierarchies are closely related to each other; from the user's perspective, there is a one-to-one correspondence between a class in the interpreted hierarchy and one in the compiled hierarchy. The root of this hierarchy is the class Tcl Object. Users create new simulator objects through the interpreter; these objects are instantiated within the interpreter, and are closely mirrored by a corresponding object in the compiled hierarchy. The interpreted class hierarchy is automatically established through methods defined in the class Tcl Class. user instantiated objects are mirrored through methods defined in the class Tcl Object. There are other hierarchies in the C++ code and OTcl scripts; these other hierarchies are not mirrored in the manner of Tcl Object.

Further details regarding NS-2 can be found from the following list

a) NS-2 home page & its mailing list
b) 'NS by Example' Jae Chung & Mark Claypool
c) Marc Greis' "Tutorial for the Network Simulator NS"

Summary of salient simulation parameters taken is presented in Table I. Performance evaluation of different routing protocols under four different TCP varients is analyzed for varying network density with respect to packet delivery ratio, and throughput performance metrics.

Table I *Salient Simulation Parameters*

Parameter	**Value**
Simulation time	150 Sec
Simulation area	1500m x 1500m
Antenna	Omni antenna
No. of nodes	40, 60, 80, 100
TCP Varients	TCP-RENO,TCP-TAHOE, TCP-SACK, TCP-VEGAS
Interface Queue Type	DropTrail-PriQueue, RED
Packet size	512 Bytes
Max queue length	50
Traffic	FTP
Routing protocol	DSDV, OLSR
Mobilty Model	Random Waypoint Model
Simulation time	150 Sec

Figure 2 shows the throughput when the network density is varied between 40 to 100. The throughput of DSDV is higher than OLSR under TCP-TAHOE without RED and with RED. With Active Queue Management technique-RED, simulation results shows improvement in throughput of these routing protocols under congested network environment.

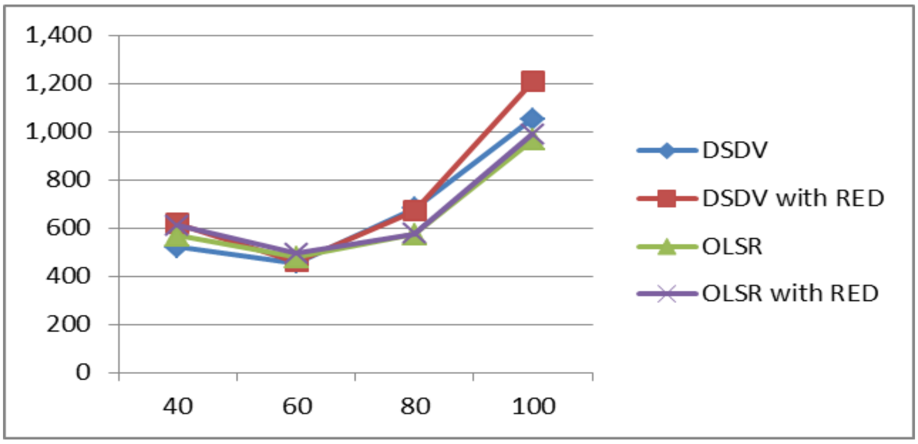

Figure 2:Throughput for DSDV and OLSR with and without RED

Figure 3 shows the packet delivery ratio when the network density is varied between 40 to 100. The packet delivery ratio of OLSR is higher than DSDV under TCP-TAHOE without RED and with RED. With Active Queue Management technique-RED, simulation results shows improvement in packet delivery ratio under congested network environment. After analysis of simulation graph for routing protocols under TCP-TAHOE with Active Queue Management technique RED, there is improvement in quality of service of routing protocols under congested environment. So the performance of DSDV and OLSR is evaluated for other TCP variants-TCP-RENO, TCP-SACK and TCP-VEGAS.

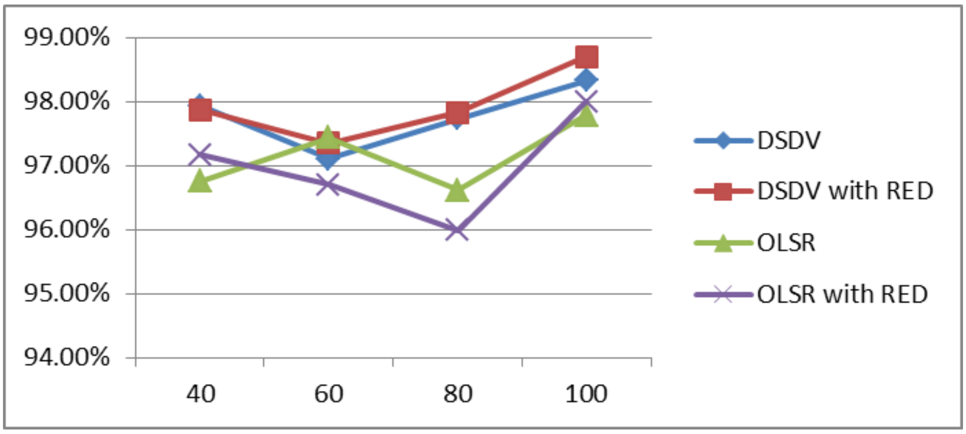

Figure 3: Packet Delivery Ratio for DSDV and OLSR with and without RED

Figure 4 shows the throughput when the network density is varied. The throughput of DSDV is higher than OLSR under TCP-RENO which means DSDV is better than OLSR.

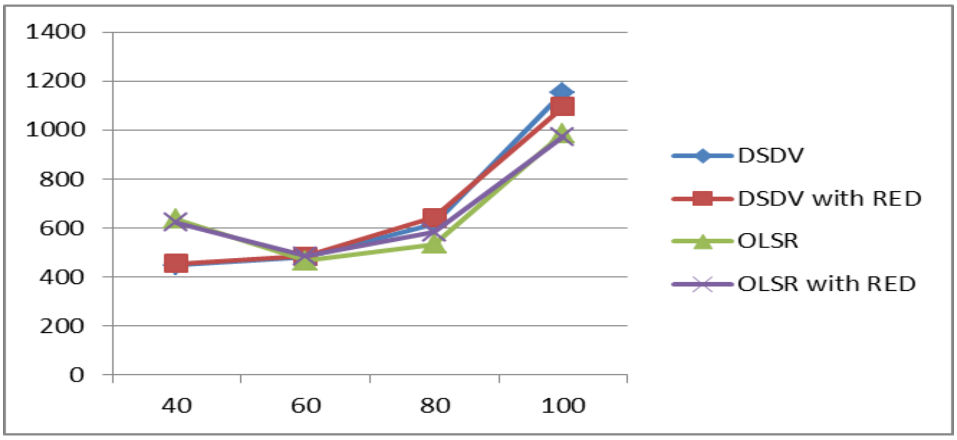

Figure 4: Throughput for DSDV and OLSR with and without RED

Figure 5 shows the Packet Delivery ratio when the network density is varied. The packet delivery ratio of DSDV is higher than OLSR.

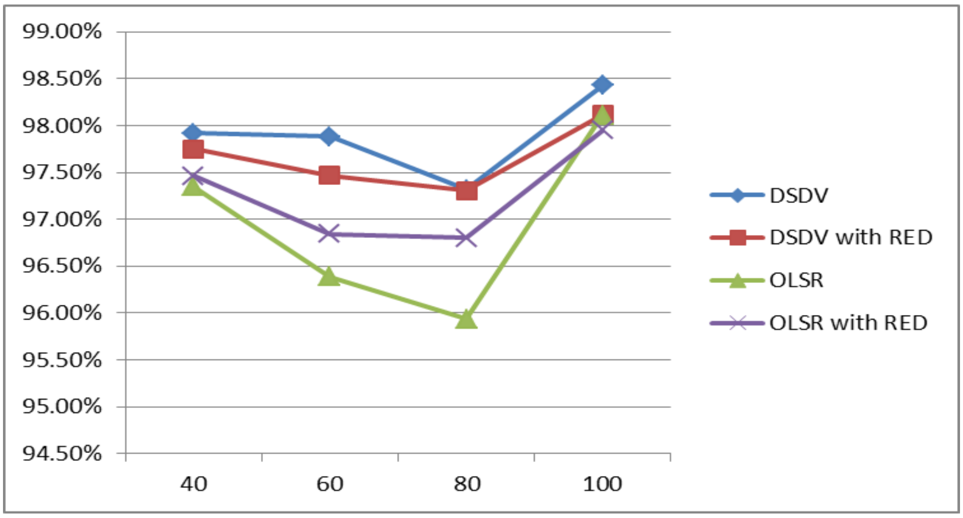

Figure 5: Packet Delivery Ratio for DSDV and OLSR with and without RED

4.3 TCP-SACK

Figure 6 shows the simulation result for throughput of DSDV and OLSR routing protocols under TCP-SACK.

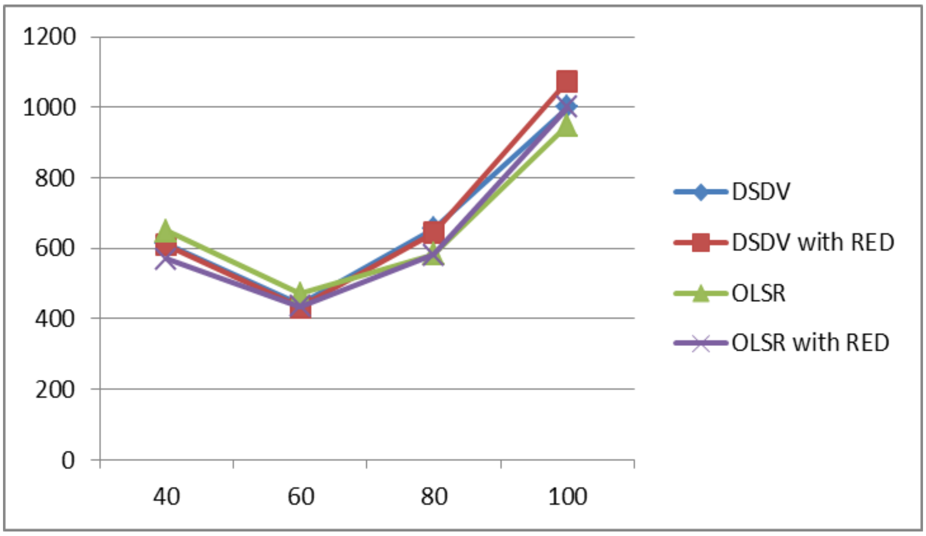

Figure 6: Throughputfor DSDV and OLSR with and without RED

Figure 7 shows the simulation result for Packet Delivery Ratio of DSDV and OLSR routing protocols under TCP-SACK.

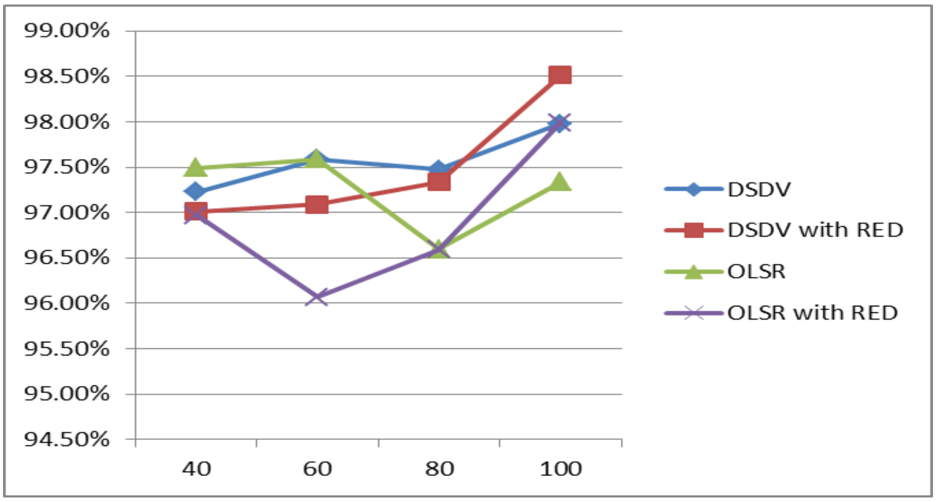

Figure 7: Packet Delivery Ratio for DSDV and OLSR with and without RED

Figure 8 shows the simulation result for Throughput of DSDV and OLSR routing protocols under TCP-Vegas.

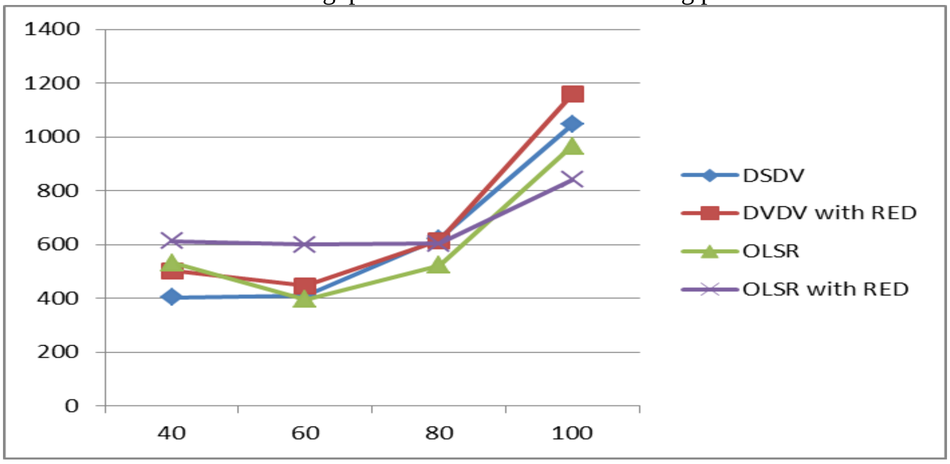

Figure 8: Throughputfor DSDV and OLSR with and without RED

Figure 9 shows the simulation result for Packet Delivery Ratio of DSDV and OLSR routing protocols under TCP-Vegas.

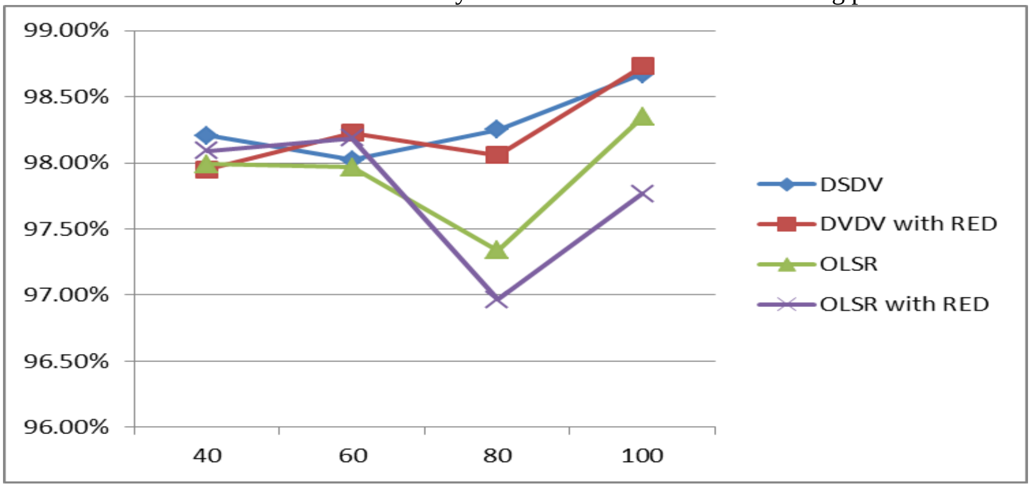

Figure 9: Packet Delivery Ratio for DSDV and OLSR with and without RED

IV. LITERATURE REVIEW

S.Rajeswari, Dr.Y.Venkataramani (2012), had discussed that QoS improvement has been a subject of intensive discussion. In this paper, the author evaluate the performance of four queuing disciplines (FIFO, PQ, RED and WFQ) which is implemented in the AEERG protocol. In this study, we presented a simulation-based performance evaluation and comparison of three queuing techniques for different number of nodes, packet size and pause time for the impact of using random-early drop as compared to drop-tail policy and weighted fair scheduling. In this protocol, the nodes can be in active mode with probability 1-p or sleep mode with probability p which is fixed at the initial stage. In this work, set a counter B to adapt the number of neighbors to which a packet is forwarded. B represents the current number of neighbors at each node which are kept in active state. The value of B is adaptively adjusted based on the packet delivery ratio. This results in less energy consumption and more reliability in the communication networks. When a particular node is selected for the forwarding of packets from different flows, congestion will occur. To ease the congestion and to increase the throughput, different scheduling mechanisms are implemented and the results are discussed. The simulation results show WFQ that outperforms other disciplines in terms of throughput and packet delivery ratio although RED are also very close to it for the considered node scenarios. In this, the author also noticed that using RED has greatly improved all the performance measures especially with FIFO. The reason is that RED monitors the average queue size and randomly drops packets when congestion is detected.

Visvasuresh Victor Govindaswamy, Gergely Záruba and G.Balasekaran (2006), In this paper, the author present a mathematical model for anovel TCP congestion control approach called Receiver-Window Modification (RWM). RWM could be used with any ofthe present Active Queue Management (AQM) schemes, such as Random Early Detection (RED), Adaptive Random Early Detection (ARED), and BLUE queues to reduce congestion atthe ingress and gateway routers. The author extended the work to stochastic modeling of RED-ECN gateways to RED-RWM gateways. Using this model, we provide a weak convergence theorem for the number of connections; thus leading the way to more relaxed configuration of RED-RWM gateway parameters. The used technique is Monte Carlo simulation method to compare outcomes of our mathematical model with those of NS2 simulation experiments. The author, "theoretized" that the RWM modified RED queue will weakly converge to a steady state and that as the number of clients (TCP connections) grows, the queue size will weakly converge to the number of clients, assuming that the minimum marking threshold (Thmin) is less than the number of clients. Our current work is focused on proving lower an dupper limits on the instantaneous and average queue sizeswith respect to various serving rates and marking thresholdvalues (Thmin, and Thmax) in complex network topologies.

Younghwan Yoot and Dharma P. Agrawali (2007),discussed in this the relation between distance and hop count first. Then, based on the relation, the required hop count between two given L1MNs is estimated. With the distribution of distance between pairsof MNs, this paper also suggests the optimal transmission power of MNs, which can guarantee delay constraints of a requested ratio of connections in an entire network. All problems are investigated in both a two-dimensional and a three-dimensional area. Simulation results substantiate the accuracy of the proposed approximation methods. The errors of the hop count estimation method are just 0.88% and 2.33% in a 2D and 3D area.

Chen, I. Marsic, R. Miller (2008), analyze the TCP performance in multi hop wireless networks based on the injected traffic and the control traffic. Injected traffic is mostly dependent on the optimal congestion window size which is proposed to be between n/3 and n/2, where n is the total number of hops. Setting a fixed cwnd reduces the applicability of TCP. Therefore the literature focuses more on reducing the control traffic to increase TCP throughput. Due to the underlying MAC layer, the transmission overhead time for longer data packets and ACK packets are almost of the same order of magnitude. To reduce ACKs, the strategy of using large ACK delay timeout does not work well always. If the congestion window is small, the receiver waits for ACK delay timeout to send the ACK, which leads to underutilization of the network. The literature proposes TCP sender to put the current value of congestion window (cwnd) in the option field of TCP header, thereby informing the receiver about its congestion window size. When the receiver calculates that the received but unacknowledged packets equal cwnd, it knows that the sender is waiting for an ACK to proceed with sending the remaining packets and sends an ACK immediately. These self-triggered ACKs lessen the need to send ACK for every data segment and thereby reduce the control traffic, which in turn leads to increased TCP throughput performance.

C. Chen, H. Wang, XinWang, M. Li, A.O. Lim (2009), the authors propose a receiver-aided mechanism in which the TCP receiver monitors the contention state of the connection and accordingly informs the TCP sender about it via ACK mechanism. TCP receiver uses end-to-end delay as contention criteria.

W. Long and W. Zhenkai (2010), TCP New-Reno tries to overcome the issues present in TCP-Reno by modifying the fast recovery mechanism. During fast recovery, when a fresh ACK is received TCP New-Reno handles them as below :

- If it ACKs all the segments which were outstanding when TCP New-Reno entered Fast Recovery, then it exits Fast Recovery and sets cwnd and ssthresh and continues congestion avoidance.
- If the ACK is partial then it deduces that the next segment in line was lost and retransmits that segment and sets dupacks to 0. It exits Fast Recovery when all the data segments in the window are acknowledged, until then every progress in sequence number generates a redundant packet retransmission which is instantly acknowledged.

TCP New Reno suffers from the fact that it takes one RTT to detect each packet loss. When the ACK for the first retransmitted segment is received, only then can we deduce which other segment was lost. To achieve TCP-LBA mechanism a few changes are performed on TCP header. Firstly, Sequence number field in the TCP header is changed to total number of pieces. Secondly, the Acknowledgement number field in the TCP header is changed to the number of the current packet. Thirdly, out of 6 bit reserved field in TCP header 2 bits are made use of. Of the four values that can be generated using the 2 bits packet type, two are made use of and the remaining two are reserved. When TCP sender is sending packet it fills the field packet type with value 0x00

S. Prasanthi, S. Chung, C. Ahn (2011),The Authors in propose a mechanism called DDLRP (Detecting and Differentiating the Loss of Retransmitted Packets) which detects and differentiates the loss of retransmitted packets and reacts by retransmitting the packet without waiting for the retransmission timeout. DDLRP consists of two schemes, namely, Retransmission Loss Detection and Retransmission Loss Differentiation.

Parbu and Subramani (2012), discussed about AODV, DSR and TORA routing protocols. In this authors present overview, characteristics, functionality, benefits and limitations of routing protocols and 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. In this, the performance analysis of various on-demand/reactive routing protocols (DSR, AODV, and TORA) on the basis of routing overhead, end-to-end delay, path optimality performance metrics are consered. From the result conclusion, this comes TORA outperforms in all the given cases.

Broch, Maltz, Johnson, Hu and Jetcha (1998), performance analysis of four routing protocols namely DSDV, TORA, AODV and DSR is done using ns2 simulator. A number of scenarios are generated with different mobility patterns and traffic loads of Constant Bit Rate (CBR) Traffic. The performance of each protocol is analyzed and explained the design choices that account for their performance. Results indicate that reactive routing protocols are more suitable for ad hoc networks and AODV performs almost as well as DSR at all mobility rates and movement speeds and accomplishes its goal of eliminating source routing overhead, but it still requires the transmission of many routing overhead packets and at high rates of node mobility is actually more expensive than DSR.

Ipsita Panda (2012), gave overview about various routing protocol for QoS parameter in MANETs. As different applications have different requirements, the services required by them and the associated QoS parameters differ from application to application. For example, in case of multimedia applications time, bandwidth requirement, power requirement, probability of packet loss, the variation in latency (jitter), Route acquisition Delay, Communication Overhead, Scalability are the key QoS parameters, whereas military applications have stringent security requirements. For applications such as emergency search and rescue operations, availability of network is the key QoS parameter. In WNs the QoS requirements are more influenced by the resource constraints of the nodes. Some of the resource constraints are battery charge, processing power, and buffer space. Performance metrics consider for QoS are: time complexity, delay, jitter, scalability, packet loss rate discussed as Time complexity is defined as the largest time that can elapse between the moment T when the last topology change occurs and the moment at which all the routers have final shortest path and distance to all other routers. Delay is the time elapsed from the departure of a data packet from the source node to the arrival at the destination node, including queuing delay, switching delay, propagation delay, etc. Jitter is generally referred to as variations in delay, despite many other definitions. It is often caused by the difference in queuing delays experienced by consecutive packets. Scalability: It is the ability of a computer application or product (hardware or software) to continue to function well when it (or its context) is changed in size or volume in order to meet a user need. Packet loss rateis the percentage of data packets that are lost during the process of transmission. The time delay is the main concern for QoS of routing protocols demanding that real time data be transmitted within a definite time interval. QoS support is essential for supporting time critical traffic sessions.

Parab, A., Nikose, P., Bhosale and S.J.(2011), had discussed that TCP is being used as a highly reliable end-to-end protocol for transporting applications. TCP was originally designed for wired links where the error rate is really low and actually assumed that packet losses are due to congestion in the network. But TCP performance in wireless networks suffers from significant throughput degradation and delays. TCP uses congestion control and avoidance algorithms which degrades end-to-end performance in wireless systems. In this, we have analyzed the performance of TCP variants, which were designed to improve performance in wireless networks. An ns-2 based simulation analysis of TCP Tahoe, TCP Reno, TCP New Reno, TCP Sack, TCP Vegas and TCP New Jersey is done. The effect of Random Packet Loss Rate and mobility on the TCP variants was studied. Experimental studies show that TCP Vegas performs better than the other variants. We have analyzed the performance of the important TCP variants like TCP Tahoe, TCP Reno, TCP New Reno, TCP Sack, TCP Vegas, and TCP New Jersey in wireless environment. From this analysis we found that TCP Vegas is better than any other TCP variant in case of increasing Random Packet Loss as well as in case of increasing mobility.

V Conclusion And Future Work

In this thesis, the effect of Random Early Detection (RED) active queue management technique with different TCP variant – TCP-Tahoe, TCP-Reno, TCP-SACK and TCP-Vegas under varying congested network density is examined on to check the improvement and performance of Destination Sequence Distance Vector (DSDV) and Optimized Link State Routing (OLSR) under the FTP traffic. From the simulation results it is observed that firstly different TCP variants (TCP-Tahoe, TCP-Reno, TCP-Sack and TCP-Vegas) with DropTail queue was run without active queue management technique to evaluate the performance of routing protocols. Then all this was repeated usingRED active queue management technique. The result that came are much better. So in overall performance DSDV do better. But when we used congestion avoidance algorithm,TCP-VEGAS with RED improve the performance of routing protocol are better than other TCP variant. Further in this direction our aim is to compare the performance of these three protocols when the traffic generator is other than FTP like CBR, TELNET,and HTTP. Because these traffic generators are the representatives of the traffic in the real scenario.

References

[1] S.Rajeswari, Y.Venkataramani, “Congestion Control and QOS Improvement forAEERG protocol in MANET”,International Journal on AdHoc Networking Systems (IJANS) Vol. 2, No. 1, pp no 13-21, 2012.

[2] Visvasuresh Victor Govindaswamy, Gergely Záruba and G.Balasekaran (2006), “Receiver-Window Modified Random Early Detection(RED-RWM) Active Queue Management Scheme:Modeling and Analysis”, IEEE ICC proceedings, pp no 158-163, 2006 .

[3] Chen, I. Marsic, R. Miller, “Issues and Improvements in TCP Performance over Multihop Wireless Networks”, IEEE Sarnoff Symposium, 2008.

[4] C. Chen, H. Wang, XinWang, M. Li, A.O. Lim, “A Novel Receiver-aided Scheme for Improv-ing TCP Performance in Multihop Wireless Networks”, in Proc. of Int. Conference on Communications and Mobile Computing, pp. 272–277, 2009.

[5] W. Long , W. Zhenkai , “Performance Analysis of Improved TCP over Wireless Networks”, in Proc. of 2nd Int. Conference on Computer Modeling and Simulation, pp. 239–242, 2010.

[6] E. M. Royer, C. K. Toh, “ Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks,” *IEEE Personal Communications Magazine*, Vol. 6, Issue 2, pp. 46-55, 1999.

[7] K. Prabu, A. Subramani (2012), “Performance comparison of routing protocols in MANET”, International Journal of Advanced Research in Computer Science and Software Engineering, ISSN: 2277 128X ,Vol. no. 2, Issue 9,2012.

[8] Vikas Singla, Rakesh Singla, Ajay Kumar (2009), “Performance Evaluation and Simulation of Mobile Ad-hoc Network Routing Protocols”, IJEIT, Vol. 1 No. 1, 2009, pp no 49-53.

[9] Josh Broch, David A. Maltz, DavidB. Johnson, Y.C. Hu, Jorjeta Jetcheva (1998), “A Performance Comparison ofMulti-Hop Wireless Ad Hoc NeWork Routing protocols ”, *ACM Mobicom Conference, pp no. 86-97, 1998*

[10] Ipsita Panda (2012),” A Survey on Routing Protocols of MANETs by Using QoS Metrics” International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 10, October 2012.

[11] Parab, A., Nikose, P., Bhosale, S.J., “Comparative analysis of different TCP variants in a wireless environment”Electronics Computer Technology ICECT, 3rd International Conference on , Vol. 4,pp no. 158 – 162, 2011.

