Project Review 0: Comparison of TCP Variants over Routing Protocols in MANET

Team Members

Under the guidance of Dr. P. Varalakshmi

BATCH 1

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ŌUR DOMAIN

Major: Comparison of TCP Variants over Routing Protocols in MANET

Minor: Analyzing over Proactive and Reactive Protocols.

IETF MANET (mobile ad hoc network) has standardized AODV (ad hoc on-demand distance vector) and OLSR (optimized link state routing) as its reactive and proactive routing protocols, respectively. As Transmission control protocol (TCP) was created for Internet with fundamentally different properties, faces serious challenges when used in mobile ad hoc networks. Research is still going on MANETs which involve efficient routing considering the fact that the topology changes so frequently over time. To improve TCP performance over ad hoc network, a lot of development and enhancement have been proposed. MANET is to be simulated using NS3 simulator for this research. Fairness of TCP variants analyzed in the simulation environment to understand how reactive and proactive routing protocol has facilitated TCP Variants operation.

Topic Area Explanation

MANET and Protocols

- A mobile ad hoc network (MANET) consists of mobile wireless nodes. The wireless communication between these mobile nodes is carried out in a decentralized autonomous system. The protocols to be used in MANET depend upon the capabilities of the devices, packet drop rate and other factors.
- MANET requires efficient routing algorithm in order to reduce the amount of signaling introduced due to maintaining valid routes, and thus, enhances the overall performance of the MANET system.

Protocols

- Proactive routing protocols

  Destination Sequenced Distance Vector Routing Protocol (DSDV)

  Global State Routing (GSR)
- Reactive routing protocols:

  Dynamic Source Routing protocol (DSR)

  Ad-Hoc On Demand Vector Routing protocol (AODV):
- Hybrid Routing protocol:

  Zone Routing Protocol

Topic Area Explanation

TCP Variants

- TCP is the most reliable transport layer protocol that provides reliable data delivery from source to destination node. TCP is less preferred for ad-hoc networks, however, TCP can be modified to improve its performance.
- TCP uses Congestion Control Algorithms. TCP occur in distinct variants that incorporate TCP Tahoe, Reno, New Reno, Vegas and Dynamic Vegas. Every of this TCP variant has its characteristics and drawbacks.

TCP VARIANTS EVALUATION ON THE BASIS OF ALGORITHMS

Algorithms/ TCP Variants	TCP Tahoe	TCP Reno	TCP New Reno	TCP Westwood	TCP SACK	TCP FACK	TCP Vegas
Slow Start	Yes	Yes	Yes	Yes	Yes	E V	E V
Congestion Avoidance	Yes	Yes	Yes	Yes	Yes	Yes	E V
Fast Retransmit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fast Recovery	No	Yes	E V	E V	E V	E V	Yes
Retransmission mechanism	N	N	N	N	N	N	N M
Congestion Control mechanism	N	N	N	N	N	N M	N M
Selective ACK mechanism	No	No	No	Yes	Yes	Yes	No

(N = Normal, E V = Enhanced Version, N M = New Mechanism)

Need for the project

A MANET does not have a fixed infrastructure. Nodes are mobile so topology keeps on changing. TCP as explained above does not perform well in wireless networks, because of frequent path breaks, multipath routing, network partitioning, hence congestion control is the main issue for MANETs. If no proper approach is followed for controlling the congestion, it may even collapse the network. Since different TCP variants work on different strategies, it is necessary to identify the best performing TCP variant in MANET over various protocols. This area has not been explored to its maximum potential, and hence, research may be conducted for establishing a basis for development of new protocols for the purpose mentioned.

Project Goals

- Study the performance of the routing protocols dealing with TCP variants.
- To determine the best TCP Variants in MANET environment over renowned routing protocols
- To propose a novel idea and also compare TCP Variants with this techniques in order to enhance the efficiency of the ad hoc network.

LITERATURE SURVEY 1

Comparative study of TCP variants for congestion control in wireless network by Pooja Chaudhary , Sachin Kumar IEEE 2017

This paper demonstrates the basic congestion control strategy. There have been many variations in TCP algorithms originating from the essential TCP which has exclusively Slow Start and Congestion Avoidance mechanism to the variation and extension of latest mechanism.. Every TCP variant has its characteristics and drawbacks. This paper describes the comparative study of five TCP variants such as TCP Tahoe, TCP Reno, TCP New Reno, TCP Vegas and TCP Dynamic Vegas, their slow start ,congestion avoidance and Congestion detection algorithm and also analyze the best extensively used TCP variant abstractly and further investigate the possible future research field. In several packet losses, the behavior of TCP New Reno is best. The shortcoming with TCP New Reno is that it hold single RTT to discover packet deficit. TCP Vegas perform best in high congested network, it recognize congestion before it arise. But still there are many issues in TCP Vegas, when TCP Vegas share a same bottleneck connection with TCP Reno, it build rerouting, fairness problem.

https://ieeexplore.ieee.org/document/8229880

LITERATURE SURVEY 2

Performance Survey of MANET Routing Protocols with TCP Congestion Control Algorithms by Suparna Banerjee; Arindam Ghosh; Sourav Mahapatra; Raja Karmakar IEEE 2020

The paper in consideration have discussed about the different categories of routing protocols and also, different TCP congestion control algorithms used in MANET routing. The application of MANETs in wireless mobile communication is evolving as an instinctive preference due to its ability to support high mobility, high scalability and very low administration, which are the essential characteristics of advanced wireless mobile communications. The research carried out here, shows the Quality of Service (QoS) lies in the performance of the routing protocols used. In this paper, they have presented a survey on the performance of different routing protocols under Transmission Control Protocol (TCP) congestion control algorithms with an objective to study the performance of the routing protocols in absence or presence of the TCP congestion control algorithms from existing literature. This paper reviews the immense importance of congestion control algorithms in MANET environment.

https://ieeexplore.ieee.org/document/9290610

LITERATURE SURVEY 3

A Comprehensive Analysis and Comparison of TCP Tahoe, TCP Reno and TCP Lite by Poonam Tomar, Prashant Panse *IEEE 2012*

There are various TCP variants and each one belongs to a different criteria. In this paper, author has discussed about the congestion problem in ad hoc networks and compare the performance of three TCP variants that all work on different techniques. This paper compares TCP variants specifically TCP Tahoe, Reno and Lite based on different parameters such as number of nodes received with error, packet loss, byte received, and throughput and pause time. A table is then drawn which shows the comparison results. Some of protocols show better response and some of them show poor responsiveness to changing network conditions and network utilization. Although there are various protocols and algorithms that have been used, there is no single algorithm that can overcome the congested and unreliable nature of network. In short, any protocol will be effective based on the parameters that are to be taken into consideration. Every variant has totally different mechanism to manage congestion in network.

https://www.researchgate.net/publication/267712138_A_Comprehensive_Analysis_and_Comparison_of_TCP_Tahoe_TCP_Reno_and_TCP_Lite

LITERATURE SURVEY 4

Performance analysis of different TCP variants in wireless ad hoc networks by Sharada U Shenoy; M Sharmila Kumari; Udaya Kumar K Shenoy; N Anusha IEEE 2017

In this paper the author has performed a comparative analysis of the TCP variants - TCP Tahoe, TCP Reno, TCP New Reno over routing protocols – AODV, DSDV and DSR using the NS-2 network simulator. These results can be further used to conduct any experiments with proper combinations of TCP and routing protocols. It can be noted that in each of the performance studies (PDR and throughput), DSR do better with TCP New Reno. Therefore the paper concludes that performance of DSR protocol is best suited while compared with AODV for applications with large number of nodes in MANETs. Performance of DSDV protocol is not satisfactory with any TCP variant. In scenarios of large ad hoc networks, DSR with TCP New Reno can be a good combination of transport and routing protocols to be used. DSDV is not preferably good for this scenario.

https://ieeexplore.ieee.org/abstract/document/8058308

Existing Works in the Field

Various existing researches have been carried out and improvised variants of TCP by only one or two measures, have been proposed. These proposed measures do not seem to be sufficient for proper analysis of improvised version of TCP. Therefore, in this paper, our objective is to evaluate the performance of different TCP variants and their results are investigated to be with different renowned (DSDV, AODV, OLSR, etc.) routing protocols, and propose the best performance tcp variant over which of the routing protocol.

Existing works in the field of MANETs compare different routing protocols on the basis of only few of the performance measures. Despite the fact that considerable simulation work has been done, still more investigation is needed in the fairness of the TCP traffic and mobility models. Fairness issues of TCP Variants in MANET including existing routing protocol are still unsolved.

Gaps identified

The UDP traffic environment table is not clearly mentioned, in spite of effective explanation of drawbacks related to MANETS. The paper has no discussion about CBR environment and hybrid protocol, which might seem to be the research gap in the particular version. Also, analysis has been done for network with static nodes where there will not be any issues of link breakages due to node mobility.

MANET network under TCP variations(TCP Tahoe, TCP Lite, and TCP Reno) using DSR routing protocol. Used NS2 by way of the imitation instrument towards education some performance parameters like packet loss, received bytes and Throughput when using FTP as network traffic with a different number of nodes. Some of TCP Protocols showed a high performance under some conditions. The conclusion of this comparison shows that none of the TCP variants can overcome the congestion of the network, each protocol can perform better under specific conditions.

Gaps identified

In, a working model of AODV as a routing protocol and analyzing its performance along with enhancing number of mobile nodes is proposed, but the proposed model is only for reactive protocols, and only AODV has been considered, which was optimized with load balancing. In few of papers cited in the reference section, Hybrid protocols are totally ignored, and performance metrics are not included and cited as required, since we cannot conclude on basis of one performance metric alone.

In few of the papers, the disadvantage of the AODV that there is a delay in routing because of route discovery process and a connection of bidirectional is needed in order to detect a single link, is neglected, which we will try to consider in the analysis of the various protocols.

Our Goal and Schedule

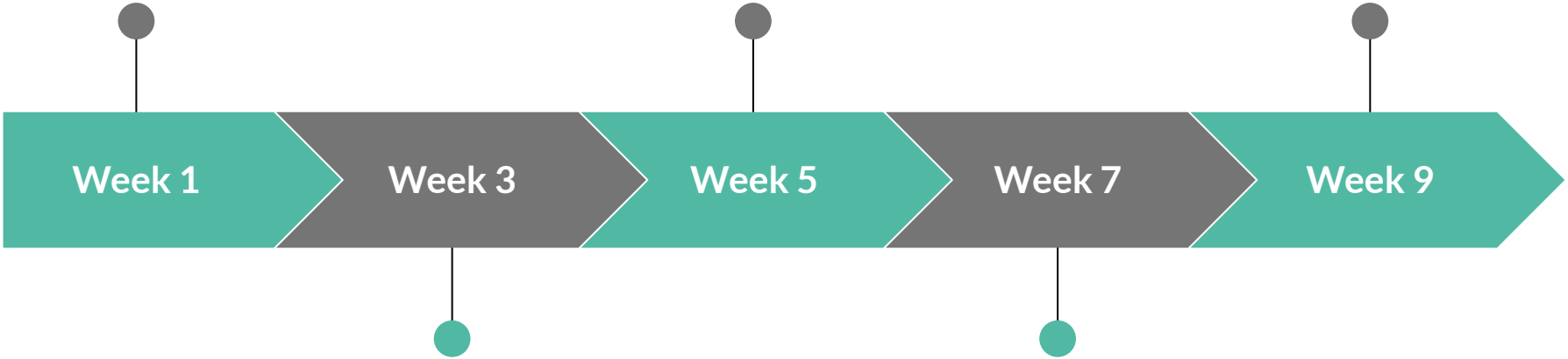
Our goal is to analyse the protocols based on different performance measures and convincingly derive at a evaluation of TCP Newreno, and suggest methods which will achieve better performance in terms of performance measures with some security features for providing quality of service networks.

Our methodology includes the analysis of various performance measures such as throughput, delay, packet drop, packet delivery ratio and number of acknowledgements. The simulation results are planned to be carried out by varying number of nodes in network simulator tool NS3.

Understand various theoretical concepts and explore NS3

Finish Comparison of variants and document the evaluation done

Finish documentation including final touches and conclude project



Simulate basic variants of TCP and begin comparison process using the NS3 simulator

Produce an effective novel idea to enhance the efficiency of the ad hoc network with respect to congestion and losses

Tools Used

Network Simulator 3

ns-3 has been developed to provide an open, extensible network simulation platform, for networking research and education. *ns-3* provides models of how packet data networks work and perform, and provides a simulation engine for users to conduct simulation experiments. Some of the reasons to use *ns-3* include to perform studies that are more difficult or not possible to perform with real systems, to study system behavior in a highly controlled, reproducible environment, and to learn about how networks work. Users will note that the available model set in *ns-3* focuses on modeling how Internet protocols and networks work, but *ns-3* is not limited to Internet systems; several users are using *ns-3* to model non-Internet-based systems.

Simulate a wireless network where the nodes move randomly with TCP flows on simulation topology. Difficulty exists to analyse fairness of TCP flows using TCP variants over routing protocols based only on mathematical and theoretical calculations. Thus, The simulation of the MANET gives a better perspective which helps us to reveal parameters influence on the MANET's behaviour, hopefully suggesting a better theoretical solution to deal with tcp congestion control and packet losses.

Goals for next meeting

1. Explore NS-3.
2. Identify and simulate apropos parameters, performance metrics like varying number of nodes, throughput, packet delivery ratio based on which the performance of TCP variants fluctuate with the help of NS-3.

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Thank you