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A Survey on TCP in VANET: Architecture, Issues

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Abstract: **Vehicular communication is an important and emerging area of research in the field of vehicular technology. The improvement of programming and equipment in correspondence frameworks prompts the era of new systems. Many researches and projects have been conducted in this upcoming area. Many government projects have been implemented in the USA, Japan and the European Union. The principle goal of utilizing this new technology is to make an accident free environment. New architectures, protocols and implementations of vehicular ad-hoc network (VANET) have been made in recent years to provide Intelligent Transportation Services. This paper incorporates survey of overall examination chip away at different issue identified with TCP in VANET. The main issue is Congestion when congestion occur number of packets are drops, some packets are also lost. To overcome this problem congestion control algorithm is used when congestion occur this algorithm slow down the transmission rate. Additionally VANET has number of difficulties like technical, social and economical. To solve this issue numerous procedures to be utilized because of this it enhances bandwidth utilization and throughput.**

Keyword: **VANET, TCP, TCP variants, Congestion Avoidance, Slow start, Fast retransmission, Fast recovery**

I. INTRODUCTION

It has been widely accepted by the academic society and industry that the cooperation between vehicles and road transportation systems can significantly improve driver's safety , road efficiency and reduce environmental impact. The advancement of *vehicular ad-hoc networks* (VANETs) has gotten more consideration and research efforts. Much work has been conducted to provide a common platform to facilitate inter-vehicle communications (IVCs). IVC is necessary to realize traffic condition monitoring, dynamic route scheduling, emergency-message dissemination and in particular, safe driving. It is assumed that every vehicle has a wireless communication equipment to provide ad hoc network connectivity. VANETs are a subset of MANETs (Mobile Ad-hoc Networks) in which communication nodes are basically vehicles. As it is involved with vehicles, its arrangement is mobile and eventually dispersed in different roads.[12]

In VANETs, vehicles can convey one another (V2V, Vehicle-to-Vehicle interchanges) additionally they can join to an infrastructure (V2I, Vehicle-to-Infrastructure) to get some service. This infrastructure is situated along the roads. Network nodes in VANETs are very portable; consequently the network topology is ever changing. In like manner, the communication connection condition between two vehicles experiences quick variety, and it is inclined to disconnection because of the vehicular developments. Fortunately, their mobility can be unsurprising along the road because it is subjected to the activity systems and its regulations. VANETs have normally higher computational capacity and higher transmission power than MANETs. [12]

II. AN OVERVIEW OF VEHICULAR ADHOC NETWORK(VANET)

There are number of criteria under in VANET like:

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A. Intelligent Transportation System(ITS)

Intelligent Transportation system implies that the vehicle itself goes about as a sender, recipient and router for broadcasting information. For communication to happen between vehicles and Road Side Units (RSUs) vehicles must be outfitted with some kind of radio interface or On Board Unit (OBU) that empowers short range wireless ad-hoc networks to be formed. In ITS vehicles are provided with Global Positioning System (GPS) or a Differential Global Positioning System (DGPS) collector for area prediction. Fixed RSUs, which are connected to the backbone network, must be in place to facilitate communication. For instance, a few protocols require road side units to be distributed equally all through the entire road organize; some require road side units just at crossing points, while others require road side units just at region borders.

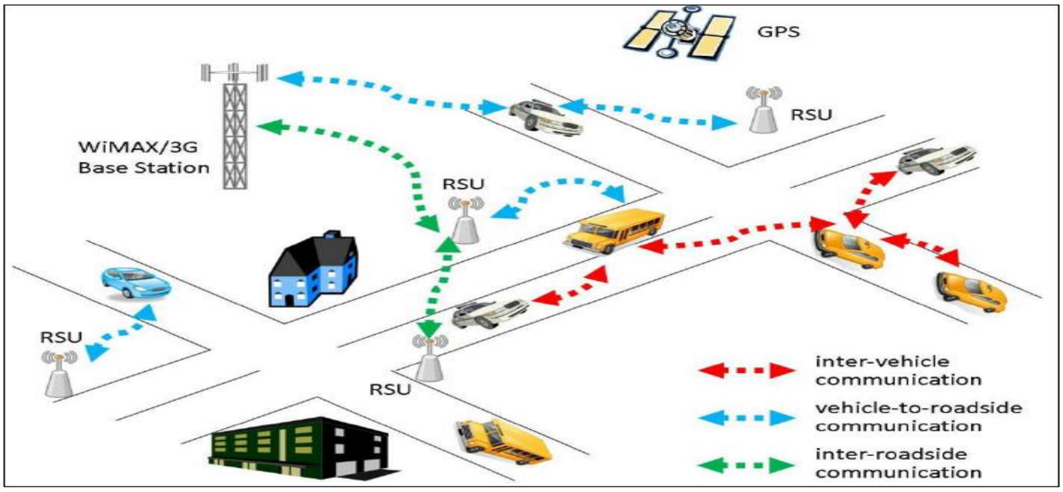

Fig.1 Architecture of VANET [12]

As shown in Fig.1.The fundamental three categories of VANET.

i) Pure-Adhoc network

The pure Ad-hoc network are use for emergencies environments where, in spite of nonexistent infrastructure. Nodes encourage one another in conveying information to and for creating the connections. In VANET environment, the communication between Vehicle-to-Vehicle (V2V) is a pure Ad-hoc because of no infrastructure needed for communication between vehicles. Adhoc networks are self-organized network and there is no requirement for infrastructure however range is constrained.

ii) Pure Cellular/WLAN Networks

In Cellular/WLAN category the network is a pure cellular and the access points are connect with internet and collect the information for analyzing. The framework is use for Vehicle-to-Base (V2I) communication for provision of data. Cellular or Remote Network based vehicular system are use for infotainment, web searching, stopping data. Cellular system still experiences a primary issue of fixed infrastructure deployment.

iii) Hybrid Networks

The Mix of Cellular and Ad-hoc network is hybrid networks and the architecture of hybrid network combine the Cellular and Ad-hoc network characteristics. The hybrid network, which utilizes a few vehicles with both WLAN and cellular capacities as the gateway, and mobile network. VANETs contain of radio-enabled vehicles, which act as mobile nodes as well as routers for other nodes. Further, the similarities to ad hoc networks, such a short radio transmission range, self-organization and self-management, and low bandwidth, VANETs can be distinguished from other kinds of ad hoc networks.

B. *Characteristics of VANET*

There are number of characteristic for VANET which is given below:

- ***High Mobility**:* The nodes in VANETs usually are moving at rapid. This make harder to predict a node's position and making security of node protection.
- ***Rapidly changing network topology**:* Due to high node mobility and irregular speed of vehicles, the position of node changes often. As a result of this, network topology in VANETs tends to change frequently.
- ***Unbounded network size*:** VANET can be executed for one city, several cities or for countries. This implies that network size in VANET is geographically unbounded.
- ***Frequent exchange of information*:** The ad hoc nature of VANET motivates the nodes to gather information from the other vehicles and road side units. Hence the information exchange among node becomes frequent.
- ***Wireless Communication*:** VANET is implemented for the wireless environment. Nodes are connected and exchange their data via wireless. Therefore some security measure must be considered in communication.
- ***Time Basic***: The data in VANET must be conveyed to the nodes with in time confine so that a choice can be made by the node and perform activity as needs be.
- ***Sufficient Energy***: The VANET nodes have no issue of energy and computation resources. This allows VANET utilization of demanding techniques such as RSA, ECDSA, and implementation and also provides boundless transmission power.

C. Challenging issues on VANET

The characteristics of VANET recognizes it an alternate network but some characteristics imposes some issues to deploy the VANET. These issues can be categorized into following categories **:**

i) Technical Challenges
ii) Social and Economic Challenges

i) Technical Challenges

The technical challenges deals with the technical obstacles which should be resolved before the deployment of VANET. Some challenges are given below:

- ***Network Management*:** Due to high mobility, the network topology and channel condition change frequently. Due to this, we can't utilize structures like tree because these structures can't be set up and maintained as quickly as the topology changed.
- ***Congestion and collision Control*:** The unlimited network size also creates a challenge. The traffic burden is low in rural areas and night in even urban areas. Due to this, the network partitions rapidly occurs while in crowd hours the traffic load is very high and hence network is congested and collision occurs in the network.
- ***Environmental Impact:*** VANETs utilizes the electromagnetic waves for communication. These waves are affected by the environment. Hence to establish the VANET the environmental impact must be considered.
- ***MAC Design*:** VANET generally utilize the shared medium to communicate hence the MAC design is the key issue. Numerous methodologies have been given like TDMA, SDMA, and CSMA etc. IEEE 802.11 adopted the CSMA based Mac for VANET.

- ***Security:*** As VANET provides the road safety applications which are life critical therefore security of these messages must be satisfied.

ii) Social and Economic Challenges

- Apart from the technical challenges to deploy the VANET, social and economical challenges should be considered. It is difficult to convince manufacturers to build a system that conveys the traffic signal violation because a consumer may reject such type of monitoring. Conversely, consumer appreciates the warning message of police trap. So to motivate the manufacturer to deploy VANET will get little incentive.[15]

III. TCP in VANET

TCP is used for Reliable communication and it is connection oriented so that used in VANET application for transferring of message. And also TCP guarantee the delivery of data.

When two vehicles are communicate then TCP is used for reliable communication also TCP is used for safety application in VANET .TCP transfer message to its destination in order if any packet is lost then also it has ACK process to tell sender that retransmit the packet because packet lost. TCP is also used for Inter infrastructure and Hybrid network.

When congestion is occur due to number of packets are sent then TCP is also reliably transfer the data at that time packet is lost and no more packets are transfer . It has also algorithm for congestion avoidance which is given below.

A. Transmission Control Protocol (TCP)

Transmission control protocol (TCP) is one of the most established and also the most basic traditions in PC networks.TCP is one of the standard tradition in TCP/IP framework. Whereas the IP protocol deals only with packets, TCP enables two hosts to set up a connection and exchange streams of data.TCP guarantee movement of data moreover that packets will be delivered in the same order in which they were sent. TCP is a connection-oriented, which means a connection is set up and maintained until the application programs at each end have finished exchanging messages. End-to-end reliable protocol designed to fit into a layered hierarchy of protocols which support multi- network applications. The TCP provides for reliable inter-process communication between pairs of processes in host computers attached to distinct but interconnected computer communication networks, manages flow control, and because it is mean to provide error-free data transmission handles retransmission of dropped or garbled packets as well as acknowledgement of all packets that arrive.

B. TCP Congestion Control Algorithm

In general the TCP deals with congestion. When congestion occur the packet is lost so overcome this problem TCP provide one algorithm that is "*TCP congestion control algorithm",*

The important strategy is that the TCP source sends packets into the network without a reservation and then the source reacts to observable events. Originally TCP assumed FIFO queuing. The basic idea is that each source determines how much capacity is available to a given flow in the network.

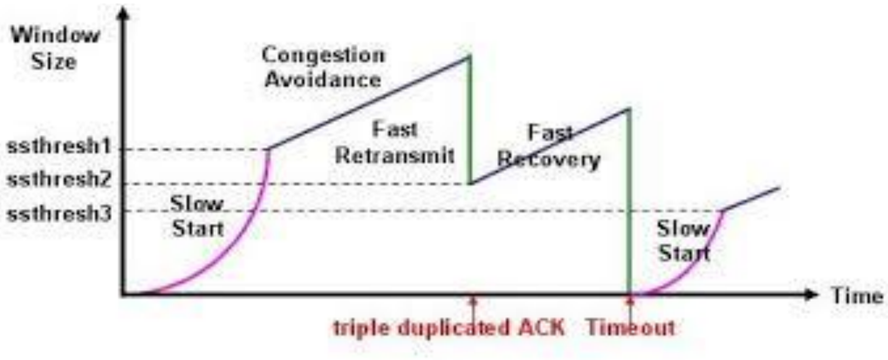

Figure.2 TCP Congestion Control Algorithm

AIMD(Additively Increase Multiplicative Decrease)

Additive Increase is a reaction to perceived available capacity. It is Linear increase meaning that each congestion window (cwnd) increased by 1 packet.

In *Multiplicative Decrease* TCP reacts to a timeout by halving cwnd. When Timeout is occur it again start to slow start and cwnd = 1 packet.

Slow Start

Slow Start, a necessity for TCP software implementations is a mechanism utilized by the sender to control the transmission rate, otherwise known as sender-based flow control. This is accomplished through the return rate of acknowledgements from the receiver. In other words, the rate of acknowledgements returned by the receiver determines the rate at which the sender can transmit data. When a TCP connection first begins, the Slow Start algorithm initializes a congestion window to one segment, which is the maximum segment size (MSS) initialized by the receiver during the connection initialization phase. When acknowledgements are returned by the receiver, the congestion window increases by one segment for each acknowledgement returned. Thus, the sender can transmit the minimum of the congestion window and the advertised window of the receiver, which is simply called the transmission window. Slow Start is actually not very slow when the network is not congested and network response time is good.

Congestion Avoidance

Congestion Avoidance is utilize to slow the transmission rate. However, Slow Start is utilized in conjunction with Congestion Avoidance as the means to get the data transfer going again so it doesn't slow down and stay slow. In the Congestion Avoidance algorithm a retransmission timer expiring or the reception of duplicate ACKs can implicitly signal the sender that a network congestion situation is occurring. The sender immediately sets its transmission window to half of the current window size (the minimum of the congestion window and the receiver's advertised window size), but to at least two segments. If congestion was indicated by a timeout, the congestion window is reset to one segment, which automatically puts the sender into Slow Start mode. If congestion was indicated by duplicate ACKs, the Fast Retransmit and Fast Recovery algorithms are invoked.

Fast Recovery/ Fast Retransmit

When packet is lost and three duplicate ACK are send by the receiver to sender and it indicate that packet is lost and send this packet again so its called Fast retransmit. After the Fast retransmit algorithm sends what appears to be the missing segment, the "Fast recovery" governs the reason for not performing slow start is that the receipt of the duplicate ACK not only indicates that a segment has been lost, but segments are most likely to leaving the network can invalidate this. When fast retransmit detects three duplicate ACKs, start the recovery process from congestion avoidance region and use ACKs in the pipe to pace the sending of packets.[10]

C. TCP Variants

TCP congestion control include slow start, congestion avoidance, Fast retransmit and Fast recovery phases. In order to improve the better execution, number of mitigation techniques have been suggested over standard TCP versions like NewReno and SACK TCP. The proactive schemes like, TCP Westwood and TCP WestwoodNR intend to improve flow control and avoid packet losses from estimation of certain network parameters like cwnd and ssthresh. Here, Westwood is modified version of Reno and WestwoodNR is modified version of NewReno. By improving the basic TCP Tahoe, Other versions Of TCPs are designed. Tahoe TCP consist of slow start, congestion avoidance and fast retransmission algorithms. But the problem with TCP Tahoe is that every time a packet is lost it waits for a timeout. TCP Reno adds "fast recovery" to the Tahoe TCP as additional feature. When a first packet lost is happened, it cuts its cwnd(congestion window) by half. But the problem with TCP Reno is in a single window whenever there is a multiple packet loss, it behaves same like TCP Tahoe. TCP NewReno is a modification made in TCP Reno, where TCP sender retransmit the packet either on reception of three dupacks(duplicate ACK) or expiration of retransmission timer. In New-Reno, partial acks do not take TCP out of Fast Recovery. Instead, partial acks received during Fast Recovery are treated as an indication that the packet immediately following the acknowledged packet in the sequence space has been lost, and should be retransmitted. Thus, when multiple packets are lost from a single window of data, New-Reno can recover without a retransmission timeout, New-Reno remains in Fast Recovery until all of the data outstanding when Fast Recovery was initiated will get acknowledged. But the problem with TCP Newreno is that when large amount of packets dropped from the window of data, TCP data send retransmit time will ultimate expire. TCP Sack option follows the format in the SACK option field contains a number of SACK blocks, where each SACK block reports a non-contiguous set of data that has been received and queued. But the problem with TCP Sack is that currently selective acknowledgments are not provided by the receiver TCP Westwood & TCP WestwoodNR introduces "faster" recovery to avoid over-shrinking cwnd after three duplicate ACKs by taking into account the end-to- end estimation of the bandwidth available to TCP.TCP Westwood utilizes the badwidth estimate to set the cwnd & ssthresh after a congestion episode. Also it utilize the same features with TCP Reno. But the problem with TCP Westwood is that it leave out the router's buffer size. Therefore, modifications done to implement TCP WestwoodNR are comparable to the ones implemented in the transition from TCP Reno to TCP Newreno. TCP-WNR was aimed to improve performance under random or sporadic losses. This version was tested through simulation and showed considerable gain in terms of throughput in almost all scenarios.[8]

D. Challenges of TCP over wireless link

1) Network execution unquestionably spoils due to package crashes on remote channels. Since pack crash on remote divert happen frequently in light of the way that all node utilize the vague remote channel to correspondence with each other.

2) Frequently courses break happen because adaptable node are constantly moving around the framework like topology frequently changes.

IV. RELATED WORK

Using different scenario for different problem new schemes and new algorithms are used in this paper which improves the different parameters :

Mohanad Al-Hasanat, KamaruzzamanSeman, have mentioned in his paper, In TCP Westwood(TCPW) a new modification is introduced to fasten the fast retransmission procedure by preventing the TCP sender side from waiting the third duplicate ACKs to retransmit lost packets. Secondly, further modification is presented to achieve better recovery for the congestion window size in the fast recovery phase based on last round trip time and bandwidth estimation.[1]

Manoj Panda, Hai L. Vu,"have implemented in his paper a new method for evaluating the throughput of a TCP NewReno connection over any network whose end-to-end packet loss process can be described by an analytical model or by any other method that results in the sequence of lost packets along the transmission. This proposal achieves more accurate results than those corresponding to the existing analytical models, with greater simplicity and less resource consumption than those necessary in a simulation.[2]

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They sugested that in TCP a new throughput model by a function of available bandwidth. Our model improves the accuracy in TCP throughput prediction by removing loss rate, which is usually hard to measure accurately, in the throughput function. Our formula-based predictor is validated by real experiments on LAN environments.[3]

They observed in his paper that in First, our model introduces an analytical characterization of the TCP NewReno fast recovery algorithm. Second, our model incorporates an accurate formulation of NewReno's timeout behavior. Third, our model is formulated using a flexible two-parameter loss model that can better represent the diverse packet loss scenarios encountered by TCP on the Internet.[4]

Young-Tae Han, In-Yong Hwang, Chin-Chol Kim, and Hong-Shik Park proposed a new attainable TCP throughput measurement tool to minimize the effect of a transient state by detecting TCP states and excluding the transient state. The evaluations are conducted on both the testbed and the Internet, and the results verify that the estimated throughput by the proposed method is closer to the actual bandwidth than that of Iperf, while maintaining the same measurement time in long distance high speed networks.[5]

They suggested that TCP combining the original TCPW sampling strategy that produces available Bandwidth Estimates (BE), with a new strategy that produces Rate Estimates (RE). Our studies show that RE works best when packet losses are mostly due to congestion. If, on the other hand, the packet losses are mostly due to link errors, BE gives better performance. To achieve the "best of all worlds", we introduce a method we call Combined Rate and Bandwidth estimation (CRB). A connection first infers the predominant cause of packet losses, and then uses the most appropriate estimation method.[6]

Ren Wang, Massimo Valla, M.Y. Sanadidi, Bryan Kwok Fai Ng, Mario Gerla implemented TCP-WNR uses this bandwidth estimation to compute congestion window and slow start threshold. These often cause conventional TCP to overreact, leading to unnecessary window reduction. Experimental studies of TCP-WNR show significant improvements in throughput performance over Reno and SACK, particularly in wired networks. Performance Results are shown that TCP-WNR is the best TCP protocol for link errors as well as congested networks.[7]

They have implemented scheme by enhanced the congestion avoidance of TCP Westwood by a new estimation to cwnd algorithm based on the network status. Also TCP WestwoodNew introduces a new estimation for Retransmission TimeOuts (RTO). RTO has been reported to be a problem on network paths involving links that are prone to sudden delays due to various reasons. Especially many wireless network technologies contain such links. Spurious RTO often cause unnecessary retransmission of several segments, which is harmful for TCP performance, and unnecessary retransmissions can be avoided.[8]

They observed that investigate the performance of OLSR and AODV protocols in a Manhattan grid scenario when sending triple TCP flow over FTP. We considered data rates of 0.1 Mbps and 1 Mbps. For the simulations, we used SUMO and NS3. We considered IEEE802.11p standard and TwoRayGroundPropaationLossModel. We use throughput and cwnd as evaluation metrics. The simulation results show that for small data rates, routing have a big effect on the performance of the network and AODV has better link stability and performance compared with OLSR. For big data rates, both protocols have almost the same performance. Because of congestion, node stack overflow and the routing have a small effect.[16]

V. CONCLUSION

In this paper, the fundamentals of VANET, its architecture, categories, characteristics, major challenging issues in VANET furthermore TCP in VANET have been inspected. TCP is reliable connection oriented protocol which is used in VANET for exchanging the information from V2V and V2I communication. Using wired and wireless scenario implementation of TCP is possible. But now a day's wireless scenario is widely used. In wireless network there are number of issues like channel error, mobility and collision. VANET and also TCP both have challenging issues. In VANET number of technical, economic and social issues arrives. To illuminate them number of methods are utilized. If traffic is increased in the network then congestion control mechanism is used in both TCP so as in VANET. In VANET if MAC layer issue is there then it is required to design of MAC layer properly. On the off chance that any security issue arrives then confirmation, approval, secrecy is to be legitimately given. TCP Westwood which give estimation of transfer speed if enhance the estimation data transmission then altered RTT utilizing transfer speed estimation capacity. For more dependability in VANET Reno and NewReno usage are accessible. Using TCP NewReno compared the performance of routing protocol like AODV and OLSR so AODV routing protocol performance is better when error is increased compared to OLSR. So using different scenario and different parameter get better implementation.

VI. FUTURE EXPLORATION SCOPE

Vehicular technology is gaining momentum as vehicles are increasing in a rapid manner. Deployment of this advance network is a necessity for many safety applications. The future of VANET is very bright as new ideas and scopes are coming up in recent times. Researchers are working in these upcoming areas to provide safety and security to mankind. There are many research scopes which are to be mined to obtain new ideas and to provide services to the people.

There are Future exploration extents of VANET:

- ***Vehicular cloud:*** Usage of distributed computing ideas can given in programming, hardware and stage level. The principle utilization of cloud computing is to provide on-demand resources to the client utilizing virtualization. By utilizing cloud, many applications are projected like multimedia services, content delivery, location sharing, e-applications, P2P services (Peer-to-Peer) and so on. The vehicles with web access can form a network cloud to provide content delivery and data sharing. The storage can also be used as a service because cars have terabytes of memory. This technology can be used for many applications and it will be an emerging area of research.

- ***Fault tolerance:*** VANET is a network and it consists of vehicles which act as nodes. The nodes can fail at any time because of hardware tampering or software fault and this leads to the generation of faulty nodes in the system. At the time of routing, if a vehicle sends data to a faulty vehicle then the data may be dropped and delay increases. Hence, there should be a recovery mechanism which recovers or protects the network from these faults. The generation of new fault tolerance techniques nowadays is also an emerging area of research.

- ***Mobility model:*** To upgrade the performance of the network there should be a realistic mobility model which implements the traffic scenario. A mobility model can be designed by considering vehicles, buildings, roads, maps, driving patterns, vehicular density, and driver's behaviour and so on. This mainly supports in solving the routing problem where the vehicles are moving at a rapid.

- ***MAC layer protocol:*** The fundamental goal of planning the MAC protocol is to provide fast data exchanges. In the WAVE standard, the IEEE 802.11p protocol is used for wireless communication. The WAVE stack consists of IEEE 1609.1, IEEE 1609.2, IEEE 1609.3 and IEEE 1609.4 to provide services like security, resource allocation, safety applications, LLC management, network services and so on. Hence, there should be a robust and efficient MAC layer protocol.

- ***Image processing:*** Image processing is a wide area of research with a huge scope. By utilizing advanced image processing algorithms, the vehicles can track a person by utilizing cameras on the vehicles. This application is used for tracking terrorists on the roads. If a terrorist's image matches with the database image then the vehicle suddenly broadcasts the information to the nearby police station. The videos of the street can also be recorded for criminal Investigation.

REFERENCE

[1] Mohanad Al-Hasanat, KamaruzzamanSeman, KamarudinSaadan "Enhanced TCPW's Fast Retransmission and Fast Recovery Mechanism over High Bit Errors Networks",*IEEE 2015 International Conference on Computer, Communication, and Control Technology (I4CT 2015*).

[2] Manoj Panda, Hai L. Vu,"An algorithm for the Evaluation of the Throughput of a TCP NewReno bulk Data flow", *IEEE COMMUNICATIONS LETTERS, VOL. 19, NO. 6, JUNE 2015*

[3] Jae-Hyun Hwang and Chuck Yoo," Jae-Hyun Hwang and Chuck Yoo", *IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 18, NO. 2, APRIL 2010*

[4] Nadim Parvez, Anirban Mahanti, and Carey Williamson,"An Analytic throughput model for TCP NewReno", *IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 18, NO. 2, APRIL 2010*

[5] Young-Tae Han, In-Yong Hwang, Chin-Chol Kim, and Hong-Shik Park," A New Attainable TCP Throughput Measurement Tool for Long Distance High Speed Networks", *IEEE COMMUNICATIONS LETTERS, VOL. 14, NO. 10, OCTOBER 2010*

[6] Sifatur Rahim, Syed Faisal Hasan, "Performance Evaluation of Fast TCP and TCP Westwood+ for multimedia streaming in wireless Environment ",*2009 IEEE International conference on computer and communication technology*

[7] Ren Wang, Massimo Valla, M.Y. Sanadidi, Bryan Kwok Fai Ng, Mario Gerla," Efficiency/Friendliness Tradeoffs in TCP Westwood", *IEEE 2002Proceedings of the Seventh International Symposium on Computers and Communications (ISCC'02)*

[8] Amit M Sheth#1, Kaushika D Patel*2, Jitendra P Chaudhari#3, Jagdish M Rathod*4, "Analysis Of TCP WestwoodNR Protocol in Congested and Lossy Network", *International Journal of Engineering Trends and Technology- Volume4Issue3- 2013*

[9] Shimaa Hagag, Ayman El-Sayed, "Enhanced TCP Westwood Congestion Avoidance mechanism (TCP WestwoodNew)", *International Journal of Computer Applications, Volume 45– No.5, May 2012*

[10] RFC5681, TCP Congestion Control

[11] Bilal Munir Mughal1,Asif Ali Wagan2, Halabi Hasbullah3," Efficient Congestion Control in VANET for Safety Messaging, *2010 IEEE paper"International Journal of Network Security & Its Applications (IJNSA)*, Vol.5, No.5, September 2013

[12] Bhuvaneshwari.S1, Divya.G2, Kirithika.K.B3 and Nithya.S4*"* A SURVEY ON VEHICULAR AD-HOC NETWORK*", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 10, October 2013*

[13] RFC793.Transmission Control Protocol

[14] Ram Shringar Raw1, Manish Kumar1, Nanhay Singh1." SECURITY CHALLENGES, ISSUES AND THEIR SOLUTIONS FOR VANET", *International Journal of Network Security & Its Applications (IJNSA), Vol.5, No.5, September 2013*

[15] Ram Shringar Raw1, Manish Kumar1, Nanhay Singh1," SECURITY CHALLENGES, ISSUES AND THEIR SOLUTIONS FOR VANET", *International Journal of Network Security & Its Applications (IJNSA), Vol.5, No.5, September 2013.*

[16] Evjola Spaho, Shinji Sakomoto, Makoto Ikeda, Leonard Barolli, Fatos Xhafa and Vladi Kolici§, "Multiflow TCP Traffic in VANETs: Performance Comparison of OLSR and AODV Routing Protocols*", IEEE 2013 Fourth International Conference on Emerging Intelligent Data and Web Technologies*