Network and Complex Systems
ISSN 2224-610X (Paper) ISSN 2225-0603 (Online)
Vol 2, No.2, 2012 www.iiste.org

A Review of Improvement in TCP congestion Control Using Route Failure Detection in MANET

S.A.Jain and Sujata K.Tapkir
MAE, Alandi (D)
Emails: sajain@comp.maepune.ac.in, sujata.tapkir@gmail.com

Abstract
A mobile ad-hoc network is an autonomous collection of mobile devices that communicate with each other over wireless links and cooperate in a distributed manner in order to provide the necessary network functionality in the absence of a fixed infrastructure. This type of network, operating as a stand-alone network or with one or multiple points of attachment to cellular networks or the Internet, paves the way for numerous new and exciting applications. Route failure is very frequent in mobile ad hoc networks as the nodes are mobile and is a very serious issue also which needs to be addressed. This paper provides an insight into the TCP congestion control mechanism in mobile ad hoc networks (MANET) and discusses the recently proposed route failure detection schemes. All these algorithms tend to increase the network performance in terms of parameters like throughput, packet delivery ratio, end-to-end delay, route reestablishment delay etc.

Keywords: ad hoc network, route failure, congestion, throughput

INTRODUCTION

At present, a large variety of networks exists, ranging from the well-known infrastructure of cellular networks to non-infrastructure wireless ad-hoc networks. Wireless ad-hoc or on-the-fly networks are characterized by the lack of infrastructure. Nodes in a mobile ad-hoc network are free to move and organize themselves in an arbitrary fashion. Each user is free to roam about while communicating with others. The path between each pair of the users may have multiple links, and the radio between them can be heterogeneous. This allows an association of various links to be a part of the same network. Mobile ad-hoc networks can operate in a stand-alone fashion or could possibly be connected to a larger network such as the Internet. Transmission Control Protocol (TCP) was designed to provide reliable end-to-end delivery of data over unreliable networks.

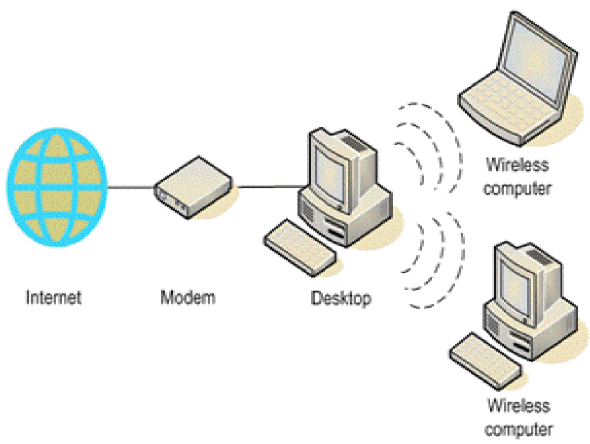

Fig.1 Ad-Hoc Network

Due to the inherent reliability of wired networks, there is an implicit assumption made by TCP that any loss is due to congestion. To reduce congestion, TCP will invoke its congestion control mechanisms whenever any packet loss is detected. However, MANETs consisting of multi-hop wireless links suffer from packet

losses due to error-prone wireless channels, media access control (MAC) layer contention, and route breakages. TCP will yield poor performance if it still interprets such losses as congestions and consequently invokes congestion control and avoidance procedures. Some mechanisms have been proposed which help TCP to distinguish between packet delivery loss due to route failure or, wireless link collisions on routes.
Part II provides a brief description of the current proposed mechanisms for route failure detection in the MANET and part III contains the comparison of the algorithms in terms of network parameters. Finally part IV gives conclusion and future scope.

II.ANALYSIS OF THE MECHANISMS

There are many algorithms for route failure detection and avoidance, some of them are explained below:

A. Node Movement Detection to Overcome False Route Failures [1]

There are two reasons of route failure in the MANET namely node mobility and wireless link collisions on routes (i.e., false route failure). If the packet delivery loss is due to the latter, unnecessary route reestablishment will degrade the network performance. This algorithm proposes a node movement detection scheme that can predict false route failures and prevent unnecessary route reestablishments by referring to changes in its neighborhood. In this mechanism, every node can determine its movement based on its neighbor table and decide whether to retransmit a failed packet or to discover an alternate route. The HELLO message is modified by adding an M flag bit to it. Every node in the network periodically broadcasts modified HELLO messages to its neighbors via 1-hop flooding. If a node receives a HELLO message with the M flag bit set to1, it updates its neighbor table and makes a prediction on its movement by calculating changes in its neighborhood. This algorithm focuses on network parameters like end to end distance and packet delivery ratio (PDR) for the static chain topology.

012 3 4 5 6 7 8 9 0 1 2 3 45 6 7 8 9 0 1 2 3 4 5 6 7 8 9

Type	R	A	M	Reserved	Prefix Size	Hop Count
Destination IP address						
Destination Sequence Number						
Lifetime						

Fig.2 Modified Hello message format

Steps for MDS:

Step1: Each node computes Vn periodically

Step2: If there is a packet delivery failure at the MAC layer, the MAC layer notifies the network layer of the failure.

Step3: When the network layer receives the notification of a packet delivery failure from the MAC layer,

If Vn < Vn_threshold
Network layer retransmits the failed packet.
The network layer increases Vn by α (penalty for retransmission)
Else
The network layer establishes a detouring alternate route.
The Vn_threshold and α are calculated by following equations.

$$V_{n_{threshold}} = \frac{\left\{(e_n - \bar{e}_n)^2 + (e_{n/2} - \bar{e}_n)^2\right\}}{2}$$

www.iiste.org

$$\alpha = \frac{\{(e_n - \tilde{e}_n) + (e_n - \tilde{e}_n - 1)^2\}}{2}$$

This algorithm was simulated in NS-2 and it was found that it gives higher TCP throughput than AODV and performs almost the same as the static routing protocol. It also gives much higher PDR compared with other schemes when nodes are static and in the mobile situation, MDS performs better than others when the traffic load is high, i.e., when the CBR rate is above 30 Kbps.

B. Divert Failure Route Protocol Based on AODV [2]

This algorithm is extension to the main AODV protocol. The main goal is to improve the reliability of routes after an existing link is going to be down due to nodes mobility. To achieve this objective, the algorithm is going to develop a very useful mechanism in order to avoid a link failure in advance and construct a new direction in locally (where the incident takes place). For this purpose, two working models are developed namely "Detection –Model and New-Path-constructor- Model (DM-NPM)".The main functions of these models are to predict the signal strength and to determine a link status before it becomes completely unavailable and find out a new direction to the destination to divert the current link into a route with a strong transmission. This algorithm focuses on network parameters like Delay, speed, distance. This algorithm was simulated in NS-2 and it was found that it avoids link failure in advance and reduces the delay resulting from sending link failure information back to the sender. Some limitations of this scheme are Low processing and Memory overhead. DFRP monitors the link to next hop and predict the link status through the signal strength. Main functions of these Models are to predict the signal strength, and to find a new route to divert the data to the new path, and improve the overall network health.

C. A Feedback-Based Scheme for Improving TCP Performance [3]

TCP Feedback is a feedback based approach to handle the route failures in MANETs. This approach allows the TCP sender to distinguish between losses due to route failures and those due to network congestion. In this scheme, the source is informed of the route failure with the help of a Route Failure Notification(RFN)so that it does not unnecessarily invoke congestion control and can refrain from sending any further packets until the route is restored with Route Re-establishment Notification(RRN). For this, it uses a single bulk data transfer session, where a source mobile host is sending packets to a destination mobile host As soon as the disruption of a route due to the mobility of the next mobile host along that route is detected, a route failure notification (RFN) packet is explicitly sent to the source and this event is recorded. This algorithm focuses on network parameters like Data rate, Failure rate, Route re-establishment delay (RDD).

This algorithm was simulated in NS-2 and it was found that it notifies the source of route failures and route reestablishments. As the route re-establishment delay grows, TCP-F performs significantly better than TCP and prevents unnecessary timer back offs during the route failure interval and performance degradation. But some limitations of this scheme are like Throughput of TCP degrades rapidly with increasing RRD and greater exponential back off. The result found that there is an improvement in performance by using TCP-F over regular TCP. So for a given time interval the number of packets passing through the network increases with data rate. Consequently, if we consider a failure that lasts for the 't' seconds, the number of packets that are lost in time 't' increases with data rate, which leads to further performance degradation in TCP. Therefore, as data rates in wireless media increase, feedback is likely to provide even greater benefits.

D. Ant Colony Algorithm in MANET [4]

This algorithm is inspired from the basic behavior which ants exhibit. Real ants deposit a substance called pheromone on the ground which helps them to find their food and shortest path from nest to food. It is a

link failure management algorithm which is based on the alternate route finding by ant agents. At the time of data flow through the link, all the nodes in the links exchange hello message which symbolizes active link. If a particular hello message does not get response, link break is detected. Node detecting link breakage will queue up the data packed and search alternate path with the help of new type of packed forward ant and backward ant. These control packets will soon find alternate path to the next node in the link. This algorithm focuses on the end-to-end delay and overhead parameter of the mobile ad hoc network.
In this case, routing table will have one additional column which contains IP address of next to next node in the active link, which is modified by RREP packet. RREP has information about all nodes present in the link i.e. generated by the destination. This algorithm improves the network throughput and also reduces the time needed to establish a route from source to destination. No Overhead in sending RERR and re-RREQ packets. This algorithm was used by the researchers in the route discovery process but its usage to improve the routing process will provide a new and exciting scope.

E. Reliable Cross-Layer Multicast with Local Backtracking [6]

In the working model of reliable cross-layer multicast, Ad- hoc networks have been studied extensively to overcome network performance problems and improve performance. In this two types of solutions have been proposed; Layer triggers and Cross-layering. The cross-layer approach allows layers to actively interact, by exchanging some specific parameters through the adjacent layers. To provide reliable multicast and increase the performance of transport communication, the scheme uses the feedback information from an intermediate multicast node on detection of a path break. It says that if path is broken then, an upstream intermediate multicast node, called PN (Pivot node), and sends a backtracking notification message to its upstream nodes and the multicast source. The system maintains a hierarchical family group to provide local retransmission. Due to the node mobility problem a PN can be aware of either a link failure or congestion when it does not receive any acknowledgment from its downstream nodes after a specific interval. Therefore it can cumulate a region that acknowledges the reception of packets or request retransmission to the upstream agent node. For the simulation probability of link broken is considered. The advantage of this scheme is that the co-ordination of buffers and local repair scheme reduces the unnecessary reroute latency and packets retransmission from source node. The simulation experiments show that in terms of aggregate throughput and TCP congestion window progression, RBM is more efficient than the others.

III. COMPARISON

All the algorithms describe above are trying to improve the performance of mobile ad-hoc networks in one way or the other by avoiding congestion. The node movement detection scheme takes into account both the reasons of packet failure, i.e, node movement and wireless link collision. It performs better than AODV in terms of TCP throughput and gives a higher packet delivery ratio when nodes are static whereas in case of ant colony algorithm, only link failure is considered. This mechanism is a modification of AODV protocol which tries to improve the throughput and end-to-end delay parameters. Probably overhead parameter will also improve as control packets used in this case are only forward ants and backward ants. On the other hand, control packets transmitted in pure AODV namely RERR and R-RREQ are not required. Divert failure route protocol uses the most popular model of radio propagation to compute the received signal powers which is not used in any other algorithm yet. In case of TCP-feedback based scheme, route failure is likely to result in gaps in the receiver's window, which adversely affects TCP's cumulative acknowledgment scheme. Therefore, it may be worthwhile exploring alternative end-to-end acknowledgment schemes such as selective acknowledgment (SACK) and comparing their performance with cumulative acknowledgment. The goal of Reliable Cross -Layer Multicast with Local Backtracking algorithm is to avoid undesired retransmission from the source and further to improve the efficiency of source-to-receivers delivery with the aid of buffer.

IV CONCLUSION

We conclude that the cause of TCP performance degradation in MANETs is due to two major problem one is TCP is unable to distinguish between losses due to route failures and network congestion. Second is TCP suffers from frequent route failures. So these different algorithms which we have studied are trying to avoid the route failures in many ways which ultimately helps to improve the TCP performance. Topics for further research include thorough mathematical analysis of buffer size and to validate different models of DFRP protocol using NS-2 simulator.

REFERENCES

[1] Hyun Yu, Sanghyun Ahn," Node Movement Detection to Overcome False
Route Failures in Mobile Ad Hoc Networks", 2008 IEEE DOI 10.1109/ICISS.2008.40

[2] Sayid Mohamed Abdule,Suhaidi Hassan," Divert Failure Route Protocol Based on AODv", 2010 IEEE DOI 10.1109/NETAPPS.2010.19

[3]KartikChandran,Sudarshan Raghunathan,SubbarayanVenkatesan, Ravi Prakash," A Feedback-Based Scheme for Improving TCP Performance in Ad Hoc Wireless Networks", IEEE Personal Comsmunications, February 2001

[4] Jyoti Jain, Roopam Gupta, T.K. Bandhopadhyay," Ant Colony Algorithm in MANET-Local link repairing of AODV", 2011 IEEE

[5] Sridhar K N, Mun Choon Chan," Modeling Link Lifetime Data with Parametric Regression Models in MANETs",IEEE COMMUNICATIONS LETTERS, VOL. 13, NO. 12, DECEMBER 2009

[6] Y.-M. Huang, M.-H. Tsai, T.-C. Chiang, T.-W. Hou," Reliable cross-layer multicast with local backtracking for improving transmission control protocol performance in ad hoc networks", The Institution of Engineering and Technology 2007

[7] C. E. Perkins and P. Bhagwat, "Destination Sequenced Distance-Vector Routing(DSDV) for Mobile Computers," Proc. ACM SIGCOMM Conf. Commun. Architectures, Protocols and Apps., Aug. 1994, pp. 234–44

[8] K. N. Sridhar and M. C. Chan, "Stability and hop-count based approach for route computation in MANET," in Proc. IEEE ICCCN 2005, SanDiego, CA, Oct. 2005, pp. 25–31

[9] Rappaport, T. S.; .Wireless Communications: Principles and Practice(2nd 107 Edition)., Prentice Hall, 2002

[10] EWA ROMANOWICZ," TCP with Explicit Link Failure Notification", Department of Computer Science, York University, Toronto, Canada

[11]Quing CHEN, Zhisheng NIU, "A delayed adaptive retransmission scheme for false route failure in MANET",2004 IEEE,10th asia-pacific conference on communications