A Reliable Path Selection Mechanism to Enhance QoS in MANET Routing Protocols

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***Abstract*— MANET is a collection of mobile nodes forming a dynamic autonomous system without using any physical infrastructure. Mobility of mobile nodes leads to dynamic change in topology of the network. The topological change in MANET leads to Path failure which degrades the network performance. A fundamental issue arising in MANETs is the selection of optimal path between any two nodes. In this paper multipath between source and destination are determined; reliability measurement is done towards node and path to predict the risk on the specified path. The proposed RSCPS Reliability Measurement is associated with Service Curve Measurement (RSCPS) to enhance the QoS through node stability, amount of data to be transmitted and bandwidth required to send the data.**

***Keywords*— MANET, Reliability measurement, RSCPS.**

I. INTRODUCTION

MANET is a collection of mobile nodes. Mobiles nodes could act as router in case of determining the path for packet forwarding and they rely on each other to keep the network connected. Network changes dynamically due to mobile nodes. Generally network users intended for Reliable delivery of information. But a topological change in MANET leads to Path failure which degrades the network performance.

Routing in MANET has been a challenging task because of high degree of node mobility. Using alternative path may resolve this problem. Multiple paths between source and destination are determined by route discovery. Routing protocol selects an alternative path based on some metrics such as hop count, speed of path, time to deliver content, path reliability, and its bandwidth.

Routing protocols in conventional wired networks generally use either distance vector or link state routing algorithms, both of which require periodic routing advertisements to be broadcast by each router. The Traditional shortest path algorithms work correctly only when all nodes maintain routes to all destinations. However, in on-demand routing protocols, a node need not maintain routes to all destinations. To overcome the problems associated with the link-state and distance-vector algorithms a number of on-demand routing protocols have been proposed for MANETs (Dynamic Source Routing (DSR) protocol and Ad-hoc On-demand Distance Vector (AODV) routing protocol etc.). The MANETs routing protocols can be classified into three different groups: global/proactive, on demand/reactive and hybrid.

In MANET single path routing may fail in most of the cases due to frequent node mobility. Consequently, Multi path routing scheme has been employed. Multiple paths between the source node and the destination nodes could be found using Multipath routing protocol. These multiple paths make the transmission more reliable and more efficient. To transmit data only best path is selected among the available paths based on some metric such as delay, bandwidth availability, delivery ratio, route stability etc.

Most MANET routing protocols do not account for gradual deterioration of link quality. For example, AODV [3] and DSR [4] in a layered architecture, routing protocols are relatively insensitive to the gradual deterioration of the quality of established routes. Building upon the ideas a new dynamic routing scheme based upon the notion of "rational swarms" is implemented called SWARM protocol. Here estimates of link quality are maintained by using "ant" packets in a similar manner to ant-colony based routing protocols. Routing protocols accounting for route stability while selecting source to destination path can be found in [6- 8].

Node mobility leads to breakdown of links, which makes link based path selection unreliable in MANET. If any link breaks its path has to replace with alternative path. The rerouting consumes the battery power and also affect the quality of service, thereby resulting in the degradation of the network performance. In our proposal an optimal path selection, based on node and path reliability is preferred to reduce risk factor involved in the network which makes network fault tolerant. Previously, the reliability of a path depends on that of all the links in it. Many routing schemes aim at finding the "shortest path" in terms of hops or links as the prime parameter[9]. Other parameters like "association stability" between two mobile nodes have been discussed[10].

In time based application there may be frequent change in traffic send, in this scenario there is no more link reliability, this increases the time complexity of Rerouting. With the rising popularity of applications, routing protocols are forced to support more number of applications with different QOS requirement. Traditional MANET routing protocols do not support time sensitive applications.

Service curve measurement (SCPS) scheme has been adopted along with path selection routing protocols to support time varying application and it is used to estimate the available bandwidth of each path. But service guarantee could be provided only by analyzing the reliability of the network.

The proposed RSCPS, initially node stability (termed as reliability) is used to select the reliable path followed service curve estimation which decreases path failure and increases packet delivery ratio.

II. Related Works

As discussed in [2] the highest amount of routing traffic is sent by the OLSR routing protocol then by TORA which is followed by AODV and lastly DSR. AODV has higher routing overhead than DSR because of multiple route replies to a single route request. DSR employs less traffic because it sends traffic only when data is ready for transmission.

In [5], with the rise of multimedia and network technologies, the bandwidth requirements of data have increased considerably. If a network link at any time is not able to meet the minimum bandwidth requirement of data, data transmission at that path becomes difficult, which leads to network congestion. The retransmission of these lost packets would aggravate the situation and jam the network. To move the traffic away from the shortest path obtained by a suitable shortest path calculation algorithm to a less congested path so as to minimize the number of packet drops during data transmission and to avoid unnecessary delay we have proposed a protocol named as Congestion Aware Selection Of Path With Efficient Routing (CASPER).

In [11] Delay-based Load-Aware On-demand Routing (D-LAOR) protocol has been proposed, which determines the optimal path based on the estimated total path delay and the hop count. In [12] both the availability and the duration probability of a routing path that is subject to link failures caused by node mobility are studied.

As discussed in [13], major issue in the design of MANET routing algorithm is the construction of stable paths. In this paper, Prediction Based Multipath Reliable Routing protocol is designed using an analytical model is proposed. The proposed analytical model estimates the link availability between two nodes using an exponential distribution of epoch lengths.

An effective application-aware path selection mechanism has been proposed to improve end-to end traffic QOS. Chance of node failure and path recalculation during service provision is high. New node may interrupt at any time whose behaviour and consistency could not be analysed as MANET is dynamic in nature. To maintain consistency and reliability in both node and path we propose a mechanism called RSCPS.

III. RSCPS Process

The proposed RSCPS Process involves three steps:

i) Initial Path Examination
ii) Reliability Measurement
iii) Service Curve Measurement

A. *Initial Path Examination*

Set of path is acquired from total number of paths by examining path statistics such as packet delay and delivery ratio. Routing protocol discovers and maintains QOS statistics for multiple paths between O/D pair [1].

B. *Reliability Measurement*

Routing protocol first examines the node in the Fault-tolerant network using Node reliability measure. Initially, duration of each node within our range is recorded in history. This value helps us to ensure reliability of node by determining how frequent and how long the particular node stabilizes in our range. Mean duration value provides average amount of time that node spend in our range. Ratio between Mean duration of node availability and time to transfer data gives node reliability measure.

Definition	Symbols
Node reliability measure	r
Path reliability index	PRI
Duration of node availability	N(t)
Time required to transfer data	T
Number of nodes in each path	n
Less reliable node	L
Risk factor	RF

Algorithm Reliability Measurement

Required Log File

1. The reliability of each node is calculated

$$r = \frac{\sum N(t)}{T}$$

2. If Reliability(r) > 0.7 the node is reliable

   else least reliable node

3. Calculate Path Reliability

$$PRI = \frac{\sum \bar{r}}{n}$$

4. Calculate Path Risk Factor

$$RF = \frac{L}{n}$$

The path which has least risk factor value is chosen as reliable paths.

C. *Service Curve Measurement*

End-to-end service curve for all reliable paths is identified using service estimation method called Rate chirp. End-to-end probing is used to estimate available bandwidth [1].

IV. Experimental Results And Discussion

A. Experimental setup

NS-2 was chosen as the platform to experiment the performance of our approach under different scenarios. In the base scenario 25 nodes were placed in a 900*900m2 areas. Similarly 50 nodes were placed in 900*900m2 and 100 nodes were placed in 1500*1000m2 Speed of the node varies from 10 up to 30m/s.

Mobility is interpreted as the combination of two simulation parameters: number of mobile nodes and their speed. Pause times were not associated with these movement profiles. In simulated environment we conduct few experiments with 25, 50, 100 nodes. Some of the parameters considered for experiments are end-to-end delay, packet delivery ratio and packet loss.

B. Performance Metrics:

The following performance metrics were used in our simulation experiments.

1) End-to-End delay (E2E):

It is the ratio between the numbers of packets received on those sent. It is defined as the average time that a packet takes to traverse the network from source to destination.

2) Packet Delivery Ratio (PDR):

It is defined as the ratio of total data packets received by the destination to total send packets by source multiplied with number of receivers. A high packet delivery ratio is desired in a network.

3) Routing Overhead

It is defined as the total number of routing packets (route discovery packets and route maintenance packets) transmitted over the network, expressed in bits per second or packets per second.

C. Implementation and Results

1) End-to-End Delay:

Our observation from Fig 1 shows that use of RSCPS in low mobility region provide us with less end-to-end delay when compared to that of delay caused by SCPS. We get low end-to-end delay in RSCPS as reliability of each path is evaluated before selecting a path. Decrease in End to end delay of particular path increases its packet delivery ratio.

The overall delay caused by SCPS is higher than RSCPS. This shows that RSCPS exhibit better performance by reducing end-to-end delay.

Fig.1. End-to-End Delay

2) Packet Delivery Ratio (PDR):

SCPS uses service curve measurement which normally increases PDR. In our proposal RSCPS uses both reliability measure and service curve measure which gives slightly higher efficiency than that is provided by SCPS. From fig 2 it is obvious that, in low mobility region packet delivery ratio of RSCPS is relatively higher than SCPS. In medium mobility region PDR of RSCPS slightly decrease due to packet loss but in case of high mobility region we get higher performance. As a result the overall performance of RSCPS is higher than SCPS.

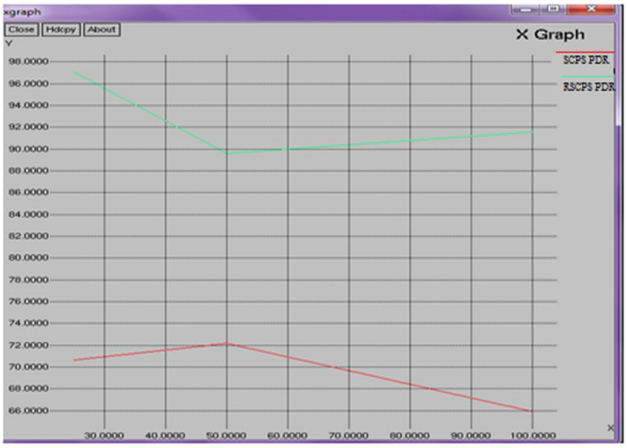

Fig.2. Packet Delivery Ratio

3) Routing Overhead

Routing overhead is increased when the network is congested or less energy consumption or due to unreliable path. The RSCPS uses both reliability measure and service curve measure which decrease the congestion and delay. Fig 3 shows that when number of nodes increases the routing overhead also increases with SCPS. RSCPS performs better in all mobility regions.

Fig.3. Routing Overhead

V. Conclusion

In this paper we have proposed a reliability aware path selection scheme which enhances the QOS provided for each application. Resulted reliable paths may yield a greater overall reliability for data transfer. As reliability play major role here, we tend to conclude that proposed system QOS will be better than traditional path selection methodology.

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