PERFORMANCE ANALYSIS OF ROUTING METRICS IN MANET

Pankaj Sharma[1] , Shruti Kohli[2], Ashok Kumar Sinha[3]

1Department of Information Technology, ABES Engineering college, Ghaziabad, UP, India
[1]sharma1pk@gmail.com
2Department of Computer Science & Engineering,BITEC,Noida,UP,India
[2] shruti@bitmesra.ac.in
3Department of Information Technology, ABES Engineering college, Ghaziabad, UP, India
[3]aksinha@abes.ac,in

ABSTARCT

Mobile Ad-hoc Network has become popular in recent years by many researchers. The objective of this paper is to implement the Multi Order Polynomial (MOP) in MANET. According to this paper , it is hypothesized that to work in MANET field , a novel approach can be used for computing routing metrics (like Packet Delivery Ratio, Normalized Routing Load, Average End To End Delay and many others). Although simulation is performed on number of routing protocols but in this paper only two routing protocols AODV(Ad-hoc On Demand Distance Vector) and DSR(Dynamic Source Routing) are tested through Network Simulator and results are obtained under different scenarios. The results obtained from simulation are validated using MOP(Multi order polynomial) expressions for the same and also computed some results and observed that the some expressions some facts are observed according to which order of polynomial performs better with minimum error rate, in this paper ninth order of polynomial expression generate the result, which is found to be satisfactory with maximum fitness value (1.0) for various routing metrics.

KEY TERMS:

AODV, Ad-Hoc Networks, DSR, OLSR, RPGM model, Curve Fitting Tool, Root Mean Square Error (RMSE), R-Square Value.

I. INTRODUCTION

In Mobile Ad Hoc Network (MANET) A number of routing protocols have been developed and proposed [1, 2], that will help in route discovery and maintenance mechanisms for the mobile node to communicate with other nodes in MANET . The main objective of all the protocols is to find the most reliable and feasible path. Since last few years, the research community has developed many routing protocols and submitted as drafts to the group of Internet Engineering and Task Force Mobile Ad-hoc Networking (MANET) . According to them the good protocols are the Optimized Link State Routing (OLSR), Zone Based Routing Protocol(ZRP),Temporally-Ordered Routing Algorithm (TORA) , the Ad-Hoc On demand Distance Vector (AODV) , the

DOI : 10.5121/ijans.2013.3102

Destination-Sequenced Distance Vector (DSDV), the Dynamic Source Routing (DSR) and many more. Here is the brief overview of these protocols

II. LITERATURE SURVEY

A lot of research have been done in MANET area , But no one is able to provide to provide the way of computing the results. In this paper we are proposing a model to compute the metrics and some brief overview of many comparison based research.

Many research works have been compared with the different proposed ad hoc routing protocols under varying network scenarios. Like Normalized Routing Load and Average end-to-end delay these are some prominent metrics used in the comparisons. They have used Network Simulator of version 2.34 to compare , Normalized Routing load of various protocols such as OLSR, ZRP, TORA, DSDV, DSR, AODV etc. Johansson, et. al. [3] extended these simulations by comparing the throughput and delay of the protocols. Perkins,et. al. [4], focused on only comparing the two on-demand routing protocols which are DSR and AODV. Yang Cheng Hung, et. al. [5], focused on OLSR protocol compares only Node density versus speed.

Thomas Staub, et. al. [6], focused on DSR and DSDV and find out that they did not supply any valid results in the hybrid situation.

Similarly there are so many research works which have shown a number of comparisons on various routing protocols according to their perception and analyze the performance of various protocols, one scholar says that he has find the right protocol but other says he has, but in this paper we found that one protocol performs better in one network configuration and one particular environment, but it does not full fill the requirements as we change the network configuration or environment. In this paper we tried to find out the right protocol which performs better in most of the network configurations. After finding out the right protocol we are suggesting PMM (Proposed Mathematical Model) to calculate the routing metrics.

III. TOOLS & METHODOLOGY

In this paper we have used various tools such as network simulator version 2.34 (NS2.34) for getting the simulation results by writing and running the TCL script, applying the parameters in Table 1, in addition we have taken the help of traffic generation tool such as cbrgen.tcl and mobile movement scenario generation tool such as Bonmotion 1.4, after getting the results we have used the curve fitting tool of MATLAB7.0 for using some mathematical expressions and compute the results and compare the simulation results with computed results which are shown in Table 2 and Table 3.

IV. PERFORMANCE ANALYSIS USING MATLAB

With the help of this paper we are presenting some experimental results and scenarios, sample scenario is shown in Table 1. We took the help of curve fitting tool fitting type as linear model for multiple order of polynomial expression, and find out the Root Mean Square Error (RMSE), Root R-square values and we have used some constants which have different default values which are used in MOP expressions. We observed that RMSE is directly proportional to R-square value, i.e. if the RMSE value is high that means if the degree of error is high then the R-Square value low, and as we are increasing the order of polynomial expression we find that with the increasing the order of expression RMSE is gradually decreasing and R-Square value is increasing towards its ideal value that is that is “one” and finally with order nine the RMSE is zero and the R-Square value is its ideal value for both the protocols, which is shown in Table 2 for DSR and in Table 3 for AODV protocols their corresponding plots are shown in Figure 1 and Figure 2 respectively then we can observe that which order of polynomial expression gives the minimum root square error value. MOP expressions are described in equation (1) to equation (9) .

i. Polynomial Order 1

$$f(x) = p1*x + p2 \quad (1)$$

ii. Polynomial Order 2

$$f(x) = p1*x^2 + p2*x + p3 \quad (2)$$

iii. Polynomial Order 3

$$f(x) = p1*x^3 + p2*x^2 + p3*x + p4 \quad (3)$$

iv. **Polynomial Order 4**

$$f(x) = p1*x^4 + p2*x^3 + p3*x^2 + p4*x + p5 \quad (4)$$

v. **Polynomial Order 5**

$$f(x) = p1*x^5 + p2*x^4 + p3*x^3 + p4*x^2 + p5*x + p6 \quad (5)$$

vi. **Polynomial Order 6**

$$f(x) = p1*x^6 + p2*x^5 + p3*x^4 + p4*x^3 + p5*x^2 +p6*x + p7 \quad (6)$$

vii. **Polynomial Order 7**

$$f(x) = p1*x^7 + p2*x^6 + p3*x^5 + p4*x^4 + p5*x^3 + p6*x^2 + p7*x + p8 \quad (7)$$

viii. **Polynomial Order 8**

$$f(x) = p1*x^8 + p2*x^7 + p3*x^6 + p4*x^5 + p5*x^4 + p6*x^3 + p7*x^2 + p8*x + p9 \quad (8)$$

ix. **Polynomial Order 9**

$$f(x) = p1*x^9 + p2*x^8 + p3*x^7 + p4*x^6 + p5*x^5 + p6*x^4 + p7*x^3 + p8*x^2 + p9*x + p10 \quad (9)$$

We applied the MOP for AODV (Ad-hoc Demand Distance Vector) Routing protocol as well as for DSR (Dynamic Source Routing) for metrics Packet Delivery Ratio and Average end 2 end delay and Normalized Routing Load [7].

We are showing the results with respect to only Packet Delivery Fraction.

V. SIMULATION & RESULTS

We have chosen two protocols which are described above for simulations i.e. DSR and AODV based on the positive behaviors according to the metrics published in RFC 2501[7]. As per the scenario described in Table 1.

Table 1-Simulation parameters

Simulation Parameters	
Routing Protocols	AODV, DSR
Mobility Model	Random Waypoint Model
Network Activation Time	10,15,20,25,30,35,40,45,50,55
Number of Nodes	10
Simulation Area	x=800 m, y= 800 m
Speed	l=0.0 m/s, h= 20.0 m/s
Pause Time	7.0
Traffic Type	CBR
Packet Size	512 bytes
Rate	5.0 packets/sec
Number of Connections	5
Seed	1.0

A. For DSR Protocol

Table 2. Linear Model for DSR

Linear Model	**R-Square**	**Root Mean Square Error(RMSE)**
Polynomial Order 1	0.04896	0.06779
Polynomial Order 2	0.7927	0.04619
Polynomial Order 3	0.9243	0.03014
Polynomial Order 4	0.9725	0.01991
Polynomial Order 5	0.9923	0.01174
Polynomial Order 6	0.999	0.004932
Polynomial Order 7	0.9996	0.004188
Polynomial Order 8	0.9998	0.00408
Polynomial Order 9	1	0

Following Figure 1. Shows the relationship between RMSE and R-Square value for DSR.

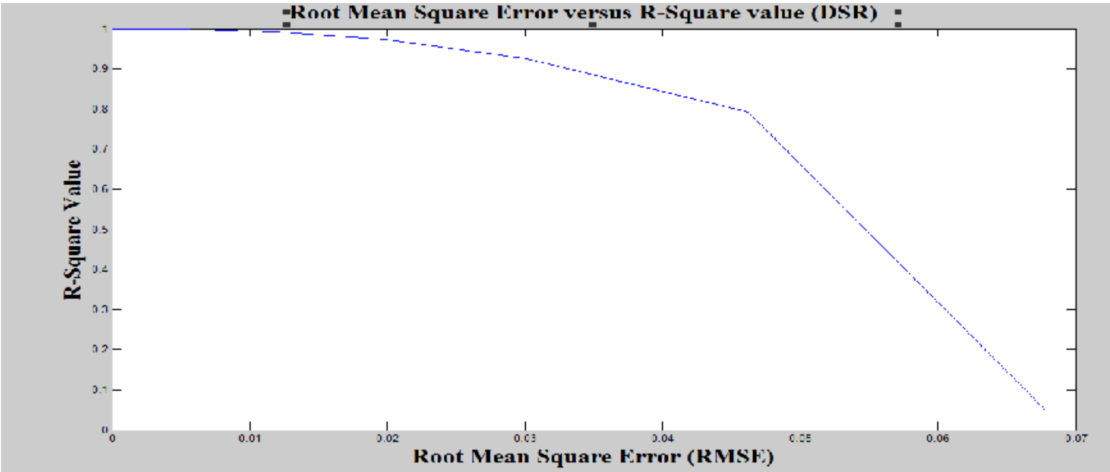

Figure 1. RMSE vs R-Square value(DSR)

B. For AODV Protocol

Table 3. Linear Model for AODV

Linear Model	R-Square	Root Mean Square Error(RMSE)
Polynomial Order 1	0.7675	0.03735
Polynomial Order 2	0.877	0.02904
Polynomial Order 3	0.924	0.02466
Polynomial Order 4	0.9773	0.01476
Polynomial Order 5	0.9961	0.006872
Polynomial Order 6	0.9986	0.004803
Polynomial Order 7	0.9994	0.003938
Polynomial Order 8	0.9999	0.001574
Polynomial Order 9	1	0

Following Figure2. Shows the relationship between RMSE and R-Square value for AODV.

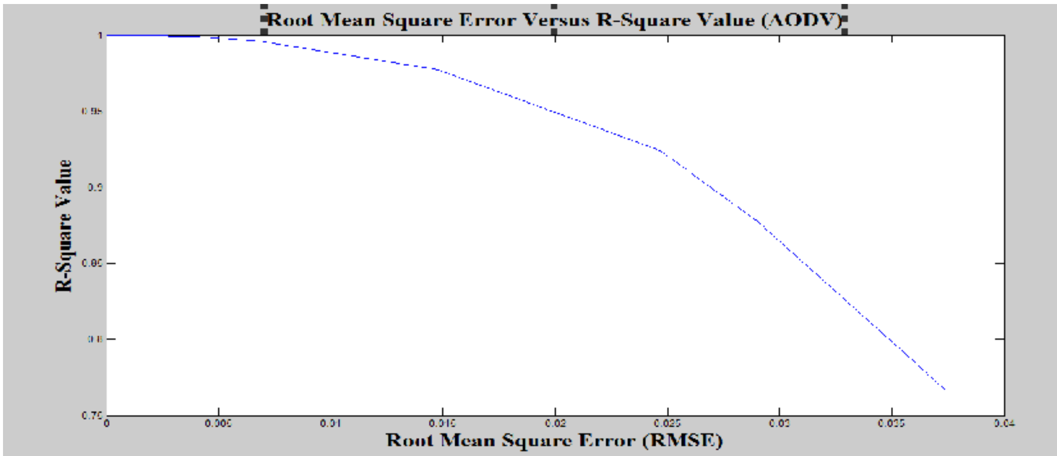

Figure 2. RMSE vs R-Square value(AODV)

VI. CONCLUSION

As it has been observed that there are number of routing protocols, among them the two protocols DSR and AODV are opted for simulation and testing, after applying the results produced from network simulator, and after applying the results to curve fitting tool under MOP type fitting expressions it is concluded that Root Mean Square Error is directly proportional to the R-Square value , so if there is a requirement for opting the right expression which provides the minimum error and more accurate result i.e. maximum the R-Square value in respect to 1.0. Thus MOP expression shows the direction for getting the minimum error rate, so it can be seen that MOP expressions are more significant for computing & validating the routing metrics for other protocols also.

REFERENCES

[1] E. M. Royer and S. B. Chai-Keong Toh, “A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks”, IEEE Personal Communications, April 1999, pp 46-55.

[2] M. Abolhasan, T. Wysocki and E. Dutkiewicz, “A review of routing protocols for mobile ad hoc networks”, http:// www.elsevier.com/locate/adhoc, Ad Hoc Networks 2, 2004, pp 1-22.

[3] J. Broch, D.A. Maltz, D. B. Johnson, Y-C. Hu, and J. Jetcheva. A performance comparison of Multi-hop wireless ad-hoc networking routing protocols. In Proceedings of the 4th International Conference on Mobile Computing and Networking (ACM MOBICOM ’98), October 1998, pages 85-97.

[4] Charles Perkins, Elizabeth Royer, Samir Das, and Mahesh Marina. Performance of two on-demand Routing Protocols for Ad-hoc Networks. IEEE Personal Communications, February 2001, pages 16-28.

[5] Yang Cheng Hung, Saleem Bhatti, & Daryl Parker titled on “Tuning OLSR” in The 17th annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC ‘ 06)[4].

[6] Thomas Staub, Computer Science Project, titled “Performance Comparison of MANET routing Protocols in Ad-hoc and Hybrid Networks” Computer Networks and Distributed Systems (RVS), Institute of Computer Science and Applied Mathematics (IAM), University of Berne, Switzerland, in February 2004.[5]

[7] [RFC 2501] S. Corson, J. Macker. Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations, January 1999.