COMPARATIVE ANALYSIS OF ROUTING PROTOCOLS AODV, DSDV, DSR &TORA IN MANET

Beenish Gul
Department of Computing
Abasyn University
Peshawar, Pakistan
beenish.gull234@gmail.com

Wajid Ullah Khan
Department of Computing
Abasyn University
Peshawar, Pakistan
arbabwajid.ullah@abasyn.edu.pk

Syed Irfanullah
Department of Computing
Abasyn University Peshawar, Pakistan
syed.irfanullah@abasyn.edu.pk

Abdus Salam
Department of Computing
Abasyn University Peshawar, Pakistan
dr.salam@abasyn.edu.pk

Usman Zeb
Department of Computing
Abasyn University
Peshawar, Pakistan
Usmanzeb007@gmail.com

Sadaf Wali
Department of Computing
Abasyn University
Peshawar, Pakistan
diyaaakhan098@gmail.com

Hafsa Naheed
Department of Computing
University of Science & Technology, Bannu
Hafsa.naheed1994@gmail.com

***Abstract*-MANET, the contraction to Mobile Ad-hoc Networks, which can also be stated to wireless mobile ad-hoc network, is a sustained self-configuring network. MANET is an infrastructure less network having the ability to communicate between nodes without any centralized administration. In MANET architecture, devices can move autonomously. As a result, they change their associations to other devices frequently. Due to varying network topologies, the selection in mobility models and routing protocol has an important effect on the performance of Ad-hoc networks. In this research, we have investigated various routing protocols such as DSDV, AODV, DSR and TORA on performance basis. Performance Evaluation of these algorithms was critically analyzed under different scenarios, such as Jitter, Latency, Collision & throughput to check which Protocol performs better in different Phenomena's. For simulations, Network Simulator (NS-2) is recommended. The recommendation of this research will provide an enhanced understanding of protocols.**

Index Terms - Ad-Hoc, AODV, DSR, DSDV, TORA, NS2

I. INTRODUCTION

MANET is the heterogeneous mixture of infrastructure-less wireless and mobile devices ranging from pocket-sized devices to laptops. As there is no centralized administration to form a temporary network the inter connections in MANET among nodes have the proficiency of changing on repetitive basis. It can be used everywhere as MANET nodes are capable of transferring any kind of wireless data e.g. cell phone, satellites, ATM or any kind of router. The foremost concern of MANET is to make the data routing possible as well as easy [1, 2]. In such a network, nodes can communicate directly to each other. Battery is the key factor to the sensor, which is connected to a microcontroller and transceiver. They help in sending the information from the nodes to transport the data to the central monitor that is being used commonly. Likewise, it is used in environmental purposes. It has been observed that MANET will become the faster and cheaper networks before long. [1]. The use of Mobile ad-hoc Network (MANET) has become immense. Such as emergencies, natural disasters and rescue operations. Like wisely MANET has entered into the world of gaming, distributed computing and sensing as well. However, MANET had faced various challenges for instance scalability, routing security and power consumption because of its less secure boundaries [2]. To sort out the challenges, MANET has proposed different routing protocols.

Categorization of Routing Protocols

The routing protocols of MANET classified in three categories as Proactive, Reactive & Hybrid [1, 2].

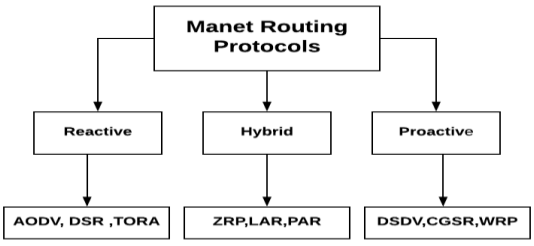

Figure.1 Classification of MANET Protocols

A Reactive Routing Protocols:

In Reactive routing protocols also known as on-demand routing protocols, the data can provided on its demand. The

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

transmission occurs when the source node request to other nodes. Reactive MANET protocols are appropriate for the nodes that send data infrequently or having high mobility. In Reactive, protocol the source node invokes the route discovery to the destination. This reactive routing protocol embraces AODV, DSR and TORA [1, 2].

1) Ad Hoc on-demand Distance vector:

AODV is reactive and an on-demand routing protocol. The routes in AODV are established when they are needed. It creates a link among the nodes in the network. These links provide different communications such as broadcast, unicast and multicast. When a node send request to the receiver it sends the sequence numbers along with all routing information. As a result, the routing information is updated and kept the same at every destination throughout the Ad-hoc network. AODV routing protocol helps to reduce the looping problem. As each packet has its sequence number, the same like DSDV. Furthermore, it helps each node to maintain sequence number along with the routing table. AODV is based on adjacent hop routing [3].

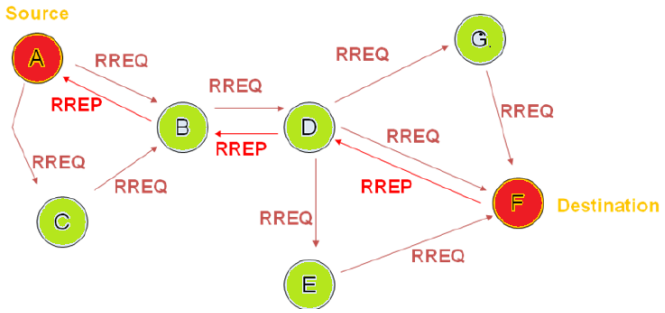

Figure 2: Packet Forwarding Process in AODV

It is quite effective in case of line breakage and changing topology in a timestamp. AODV uses (RREQ), (RREP) and (RRER) message types to communicate among nodes. Source sends the route request to the neighbour node. Each neighbour node sends the route request until it reaches the destination and destination sends RREP [4]. The message format contains the IP header address and IP broadcast address. As nodes communicate with each other, sometimes the link breakage occurs in active route. In link failure, scenario route error message is used. It informs the other nodes that line breakage has arisen. As a result, Nodes are enabling to re-establish and maintain the route.

2) Dynamic Source Routing

DSR is a reactive protocol, which is design as a multi-hop wireless Ad-Hoc network. DSR works under two broad terms Route discovery and Route maintenance. In route discovery process node sends data to the destination in order to get access to the route node. While, in Route maintenance process the node detects that the topology has been changed & is no more suitable for use. Moreover, it notifies that link along with route is no longer workable. Both of the mechanism Route discovery & of Route maintenance operates only on demand basis [7]. Network nodes co-operatively transfer packets among each other over multiple hosts. In the meantime, each packet contains packet header, which is allocated by the sender through a source route. Every mobile node takes part in the Ad-Hoc network where they built a route cache and get the source route thoroughly. When communication among the hosts arises, the transmitting node first of all validate the route cache from sender to the receiver. Once the sender found the path, it uses that path. However, if the path is not found the sender attempts a new route by using route discovery mechanism. If the sender does not receive the RREP, it may cause the link failure. This failure is identified by the MAC layer. The core functionality of DSR is the route maintenance technique and its operation handling of the route. Furthermore, it notifies the sender about of routing errors.

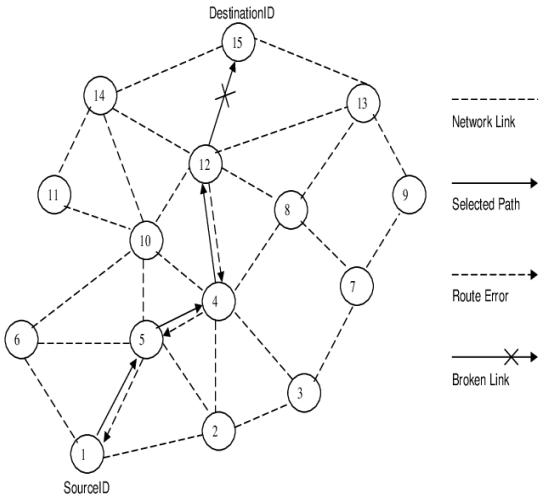

Figure3: Route Mechanism in DSR

3) Temporally Ordered Routing Algorithm:

TORA is on-demand and a source-initiated routing protocol, which works on the concept of path reversal of the directed A-cyclic Graph (DAG) [8]. This topology improves the validity of communication. Comparatively, DAG performs well then, a tree because there are multiple paths from source node to the destination. It enhances the lifetime of a large network. TORA is a bandwidth-efficient and loop-free protocol. Furthermore, TORA has the property to repair the route quickly during link failure. In addition, it makes available numerous routes for the desired source/destination. It works well in such networks where traffic increases gradually. Due to high adaptability, TORA operates in a dynamic network. It uses the Parameter "Height" which greatly

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

emphasizes on the direction of the path between the nodes. It is a Label-based multipath routing (LMR) Protocol. LMR is

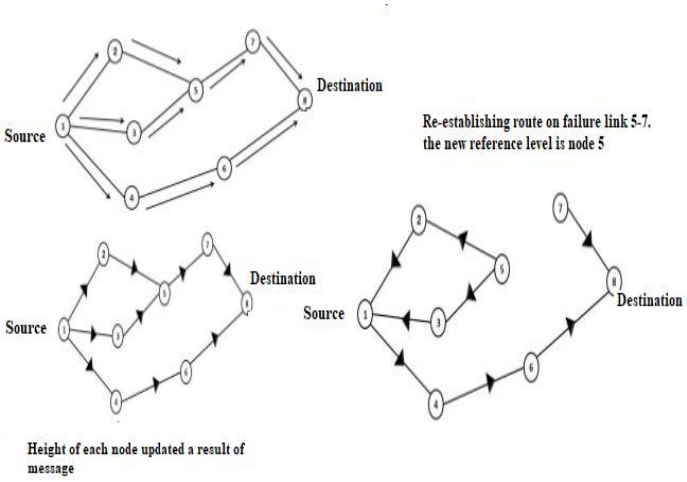

Figure 4: DAG Mechanism in TORA

Suitable for using in localized information only. In addition, it can protect the working path as well. The main theme of TORA is to reduce the control message propagation in a highly dynamic situation. which is done by the nodes that request path only when they need to send the packet to the destination. Synchronized clock in TORA leads it to limitation upon its reliability [8, 9]. TORA works in the following three stages route erasure, route discovery and route maintenance. Route establishment is based on a DAG mechanism that ensures the loop-freeness of all the routes.

B Proactive Routing Protocols

DSDV, GSR, and WRP belong to the proactive classification. In proactive (table-driven) technique, the data of every host in the routing table is stable and updated. An individual routing table that occupies routing information in the network allocates each node [2].

1) Destination Sequence Distance Vector Routing

DSDV lies in proactive routing protocol's category it is a bellman ford-based routing protocol [5]. This is design for Ad-hoc networks to overcome the routing loop issues. Moreover, each node in DSDV Ad-hoc network maintains two routing tables. These routing tables contain a sequence number that provides destination information. Based on this phenomenon the information travels among the Ad-hoc network nodes. Besides that, the nodes update the routing table by broadcasting frequently. When two updates are having the equivalent number then small hop count is used. DSDV enhances the predictability of changing topology. The main aim of DSDV is to update the routing table frequently. For this reason, the battery power is consumed and little bandwidth is still used when the network is not functioning. DSDV causes unidirectional link problems dumping function. As a result, it is not suitable for multiple tracking [6]. The main feature of DSDV is to overcome the looping problem.

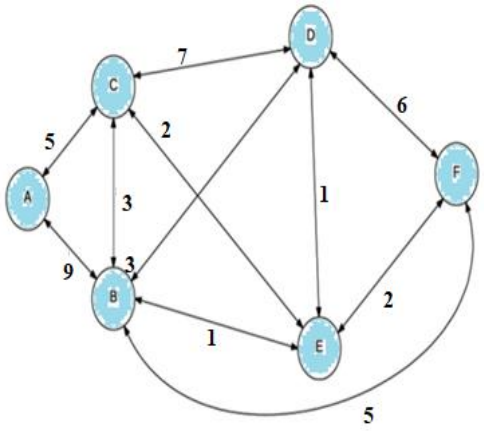

Figure 5: Routing process of nodes in DSDV

C Hybrid Routing Protocols

This Approach is the combination of the table-Driven and on demand-driven approaches. ZRP and LAR exist in hybrid protocols [2].

.

II. RELATED WORK

Mobile ad-hoc network is type of Wireless sensor network with no Access point [3]. Uniquely identification of Ad Hoc network is that the functionality and structure of such type of network is assign to infrastructure Components. Such as routers, switches & Access Points. Due to infrastructure less and Dynamic topology behaviour causes many challenges such as Security, battery power, scalability etc. A lot of research work has been carried out in the development of routing protocols. Comparison, simulation and systematic enhancement have been done on different Routing protocols. Protocols compared and analysed based on different parameters with the different network size.

Mandeep Kaur and Krishan Kumar Compared three routing protocols based on jitter, throughput, Delay and PDR. According to their finding shows, that DSR has lower Jitter on less speed because of its route information utilization stored in the route cache for creating the connection. For the higher speed, DSR has more Jitter. Throughput of AODV & DSR is much better than DSDV. AODV and DSR both have more delay than DSDV. AODV delay is less than DSR. The result

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

shows that AODV performs much better than DSR and DSDV [11].

Mr. Amit D. Chavhan and Prof. S.S.Asole they work on routing protocols in MANET. According to their analysis results DSR and AODV shows good results than the others. DSDV shows same result in all circumstances. However, TORA gave poor result [12].

According to Dr. Gurjeet Singh & Er. Manish Goyal the Latency of Proactive Protocols like DSDV is always minimum while long Delays exists in Reactive protocols e.g. (DSR, AODV, and TORA) due to non-availability of a route [13].

Sachin Kumar Gupta & R.K. Saket used two types of data packets UDP & TCP. According to their Graphical analysis and simulation result by using NS2 simulator about the two routing protocols. Their performance evaluation is considered, which is based on performance metrics Like Jitter, Throughput, delay. According to their result, they conclude that PDR of AODV protocol is 70% to 90% in all cases while the ratio of DSDV is 50% to75 %. At initial point, delay of AODV is high but after some time it gets reduces. While in case of DSDV delay was very low at the beginning and was increasing gradually. AODV gives a little bit worst performance in jitter and DSDV gives good result. Under different terminologies, it shows that AODV performance is much better than DSDV [14].

On behalf of Vishal Gupta, Bipin tripathi evaluate different protocols in MANET. According to him, collision of proactive protocol is minimum as compare to reactive protocol. His simulation result of collision about DSDV (proactive) is 11.25 while AODV is 21.20 & DSR (reactive) in terms of collision is 63.37 respectively [15].

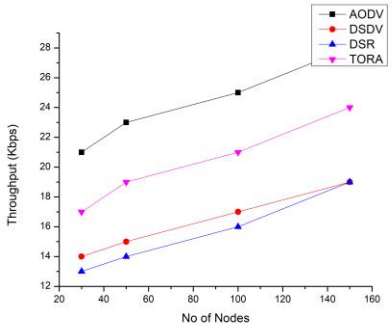

Figure 6: Number of nodes vs Throughput for network size of 450×450.

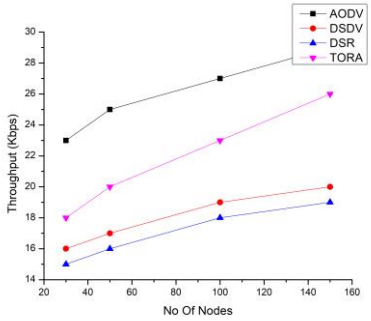

Figure 7: Number of nodes vs Throughput for network size of 750×750

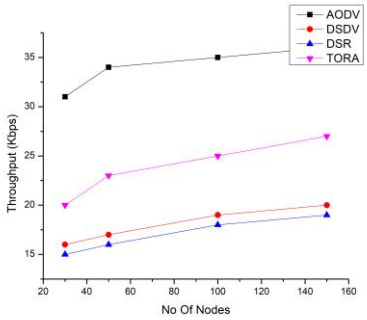

Figure 8: Number of nodes vs Throughput for network size of 1050×1050

III. PERFORMANCE MATRICES

To carry out the comparative analysis for routing protocols in MANET the following performance matrices are used.

A Throughput

The number of data transfer between the nodes per unit of time through different communication paths [10]. Its unit is bits per second (bps).

$$Throughput = \frac{PR * P\ Size}{1000} \quad [20].$$

$$where\ PR = packet\ Ratio$$
$$P\ Size = Packet\ Size$$

B Jitter

Jitter is the delay variation in the time between arriving data packets [11, 12]. Jitter occurs due to route changes in network congestion. Jitter should be minimum for the better performance of a protocol.

The calculation of jitter requires these parameters:

Tx × t of the first packet.
Rx × t of the first packet.
Tx × t of the second packet.
Rx × t of the second packet.

C Latency

Latency is a type of delay. It is define as the amount of time taken by a packet to get from one delegated point to another. Moreover, it is use to examine network speed [13].
Network Latency = Propagation Delay + Serialization

D Collision

Collision in network occurs when two or more packets Attempt to transmit the data at the same time [15]. In such case, an allotted address of a node is assign to another node, which causes collision.

Collision Probability = Pb (n,k) = 1- (n! / [(n-k)! n^k])
Where n = number of Nodes & K = number of paths.

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

IV. RESULTS AND DISCUSSION

In section IV simulation analysis of routing protocols was discussed.

The Figures 9,10,11 show the result of throughput for different network size such as 450*450,750*750 and 1050*1050. The number of nodes were used (20, 40, 80,100,120,150). According to the results of Throughput for different network sizes, AODV protocol result was best among the other routing protocols, because in AODV the paths are accomplish on demand and sequence numbers of destination used to find the fresh path to the receiver. The performance of TORA is better at high mobility rate but as the mobility decreases it performance also becomes low due to sensitivity of loss of routing packets as compare to DSDV and DSR.

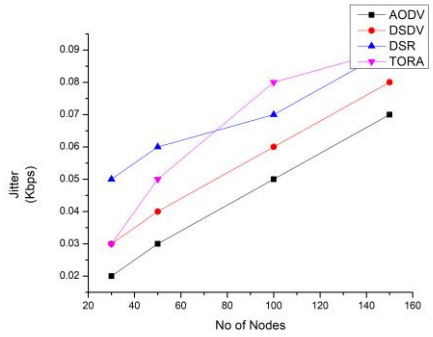

Figure 9: Number of nodes vs Jitter for network size of 450×450

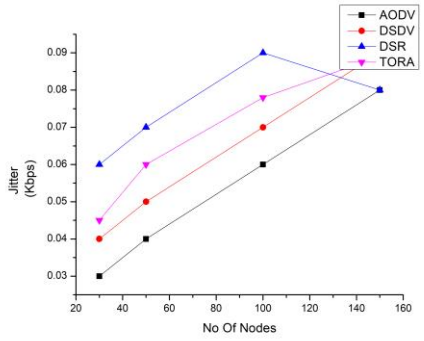

Figure 10: Number of nodes vs Jitter for network size of 750×750

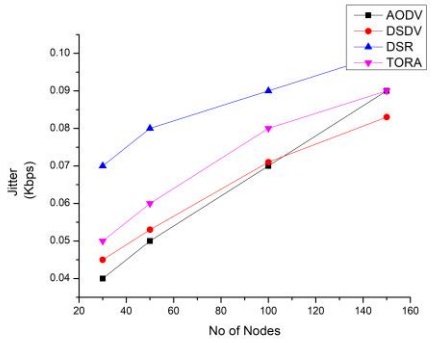

Figure 11: Number of nodes vs Jitter for network size of 1050×1050

The **Figures 9, 10, 11** shows the result of Jitter for different network size such as 450*450,750*750 and 1050*1050. The number of nodes were used (20, 40, 80,100,120….150). AODV and DSDV perform better but the results vary with the increase of network size. TORA and DSR performance were worst throughout the network scenarios. TORA has high rate of jitter due to delay in networks, timing drifts, and paths changes and network congestion.

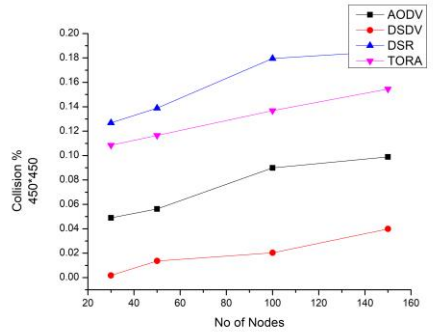

Figure 12: Number of nodes vs Collision for network size of 450×450

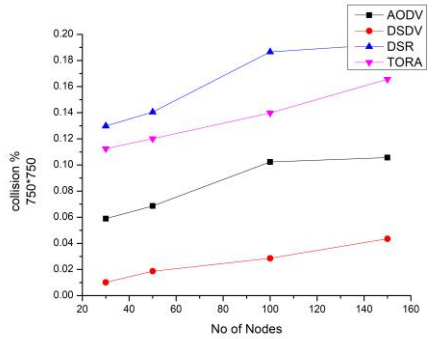

Figure 13: Number of nodes vs Collision for network size of 750×750

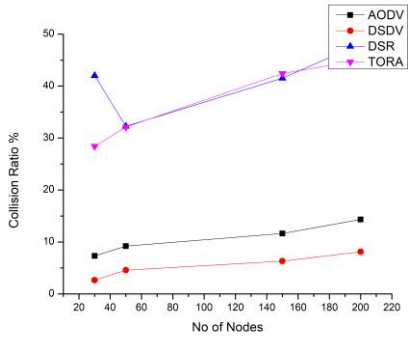

Figure 14: Number of nodes vs Collision for network size of 1050×1050

The **Figures 12, 13, 14** shows the result of Collison for different network size such as 450*450,750*750 and 1050*1050. The number of nodes were used (20,40,80,100,120….150). According to the results, AODV and DSDV perform better but TORA and DSR performance were worst throughout the network scenarios. DSR has high rate of Collision due to delay in networks, paths changes and network congestion. The performance of DSDV is best because of maintaining routing table. The rate of collision is high in reactive routing protocol as compare to proactive routing protocol.

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

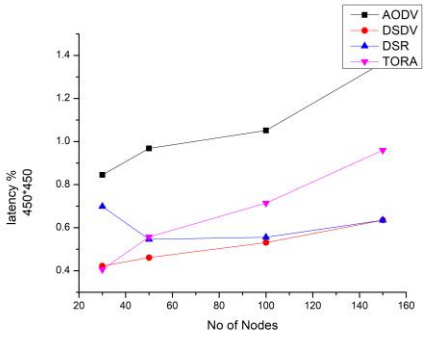

Figure 15: Number of nodes vs Latency for network size of 450×450

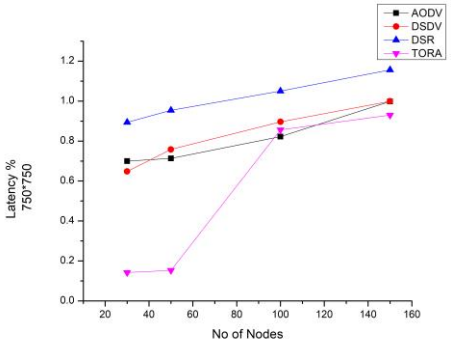

Figure 16: Number of nodes vs Latency for network size of 750×750

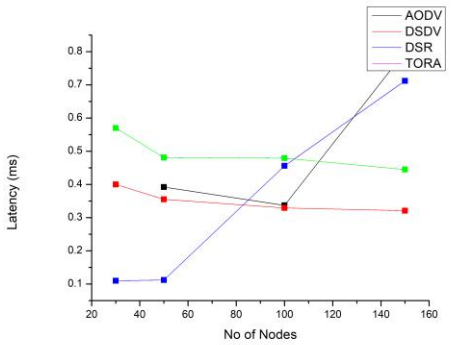

Figure 17: Number of nodes vs Latency for network size of 1050×1050

The **Figures 15, 16, 17** shows the result of Latency for different network size such as 450*450,750*750 and 1050*1050. The number of nodes were used (20, 40, 80,100,120….150). According to the results for network size of 450×450 DSR and DSDV performs better and network size of 750×750 TORA perform better as compare to other routing protocol. For network size of 1050×1050 DSR, perform better for latency. TORA has high rate of latency due to delay in networks, timing drifts, paths changes and network congestion.

Table 1: Routing Protocols Comparison for Throughput & Latency

No of Nodes	**Throughput (kb)**				**Latency (sec)**			
	AODV	**DSDV**	**DSR**	**TORA**	**AODV**	**DSDV**	**DSR**	**TORA**
30	21 kb	14 kb	13 kb	17 kb	0.9 Sec	0.42 Sec	0.7 Sec	0.4 Sec
50	23 kb	15 kb	13.5 kb	18.5 kb	0.10 Sec	0.49 Sec	0.50 Sec	0.58 Sec
100	24.5 kb	16 kb	15 kb	19 kb	1.0 Sec	0.5 Sec	0.58 Sec	0.7 Sec
150	26.5 kb	17.5 kb	17.5 kb	21.5 kb	1.3 Sec	0.6 Sec	0.6 Sec	0.82 Sec

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

Table 2: Routing Protocols Comparison for Jitter & Collision

No of Nodes	Jitter (sec)				Collision (sec)			
	AODV	**DSDV**	**DSR**	**TORA**	**AODV**	**DSDV**	**DSR**	**TORA**
50	0.03 sec	0.04 sec	0.06 sec	0.045 sec	0.0489 sec	0.0018 sec	0.1268 sec	0.1085 sec
100	0.04 sec	0.05 sec	0.07 sec	0.06 sec	0.0563	0.0136 sec	0.1389 sec	0.1165 sec
150	0.06 sec	0.07 sec	0.09 sec	0.078 sec	0.0899	0.0203 sec	0.1795 sec	0.1368 sec
200	0.08 sec	0.09 sec	0.08 sec	0.089 sec	0.0989	0.0399 sec	0.1854 sec	0.1545 sec

The Table 1 & Table 2 indicates the result generated from the simulation. The protocols checked under these four parameters. According to the simulation result, AODV & TORA performance was best in different network size as compare to other routing protocols.

V. Conclusion

In this work, we compared four routing protocols DSDV, DSR, AODV and TORA. Network simulator 2.35 carries out the simulation. Simulation parameters Throughput, jitter, collision and latency were used for analyzing the routing protocols. In terms of throughput, AODV & TORA performance was best in different network size as compare to other routing protocols. Performance of AODV & DSDV was much better for network size of 450*450 & 750*750 and performs similar for network size of 1050*1050 comparing with TORA and DSR. In terms of collision DSDV, analysis was best throughout the entire simulation. For Latency, the performance of AODV was highest for small area network but increasing with the network size Latency increase in DSR protocol. The behavior of the protocols would be simulating to analyse in realistic scenarios such as movement characteristics of protocols.

VII. References

[1] V. Srivastava, R. Tikar, R. Bhatia. “Performance Comparison of AODV & DSDV Ad-Hoc Network Routing Protocols Based on Variable Speed & Pause Time", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 10, April 2013.

[2] R. RagulRavi, V. Jayanthi, “A Survey of Routing Protocol in MANET”, (IJCSIT), 2014.

[3] C. Perkins, E. B. Royer, S. Das, “Ad hoc On-Demand Distance Vector (AODV) Routing - Internet-Draft”, RFC 3561, IETF Network Working Group, July 2003.

[4] A. Touzene, I. Al-Yahyai "Performance Analysis of Grid-Based AODV Routing Algorithm”, Int.j.Communications, Network and System Sciences, vol no. 8, pp. 523-532, 2015.

[5] C. E. Perkin, “Destination Sequence Distance Vector (DSDV)”, RFC 6126, IEEE, 1994.

[6] G. He, “Destination-Sequenced Distance Vector (DSDV) Protocol,” (IJCSIT), 1996.

[7] D. Johnson, D. A. Maltz “Dynamic Source Routing (DSR) Protocol for Multi-Hop Wireless Ad-HocNetworks”, Kluwer Academic Publisher, 1996.

[8] R. Sharma, R. Sindhu, “Study of TORA for Mobile Ad-Hoc Network”, (IJCSIT) international journal of computer science and information technologies, vol.5 (4), 2014.

[9] L. Abusaleh, A. Khokar, M. Guizani, “A Survey of secure Mobile Ad Hoc Routing Protocols”, IEEE Communication Surveys & Tutorials, Vol, 10, No.4, Fourth Quarter 2008.

[10] M. WasiUllah, H. Ali, W. Khan, et la, “Performance Assessment of Reactive Routing Protocols in Mobile Ad-hoc Networks under CBR Traffic using NS2”,

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

IEEE WiSPNET, 2016.

[11] M. K. Gulati, K. kumar, “Performance comparison of Mobile Ad-Hoc Network Routing Protocols”, (IJCNC) Vol, No.2, March 2014.

[12] Mr. Amit D. Chavhan, Prof. S.S.Asole, "Comparative Analysis and Performance Evaluation of MANET Routing Protocols", (IJCSMC), Vol. 3, pg.369-375, Dec 2014.

[13] Dr. G. Singh, Er. M. Goyal, “Comparative Analysis of Routing Protocols for Mobile Ad-hoc Networks”, (GJCST-E) Vol .12, 2012.

[14] A.A.A Radwan, T.M. Mahmoud, and E.H. Houssein, “Evaluation Comparison of Some Ad Hoc Networks Routing Protocols”, Egyptian Informatics Journal, 12, 95-106. 2011

[15] V. Gupta, B. Tripathi, “Comparative Performance Analysis of AODV, DSR, DSDV, LAR1, WRP”, International Journal of Computer Applications (0975-8887) Volume 52-NO.20, August 2012.

[16] Sachin Kumar Gupta, R.k.Saket, “Performance Metric Comparison of AODV & DSDV Routing Protocols in MANET Using Ns-2”,(IJRRAS) 7(3), June 2011.

[17] B. C. Mummadisetty, A. Puri, “Performance Assessment of MANET Routing Protocols”, Int.j.Communications, Network and System Sciences, 2015.

[18] H. Nawaz and H. M. Ali, “Analysis of Routing Protocol Metrics in MANET”, In Proceedings of 20th National Research Conference Department of Computer Science and Engineering, Management Sciences and 20th National Research Conference at SZABIST, 2014.

[19] C. Perkins, Elizabeth M. Royer, S. R. Das, “Performance comparison of two on-demand Routing Protocols for Ad-hoc Networks”, IEEE Personal Communications, pp. 16-28, February 2001.

[20] P. Kuppusamy, Dr. K. Thirunavukkarasu, “A Study and Comparison of OLSR, AODV and TORA Routing Protocols in Ad Hoc Networks”, IEEE 2011.

[21] A. Daas, Khulood Mofleh, et la, “Comparison between AODV and DSDV Routing protocols in Mobile Ad-hoc Networks”, IEEE 978-1-4799-7626-3/15/$31.00, 2015.

[22] S. Naski. “Performance of Ad Hoc Routing Protocols Characteristics and Comparison”, Helsinki University of Technology Telecommunications Software and Multimedia Laboratory HUT T-110.551 Seminar on Internetworking Sjökulla, 2004.

[23] A. Boukerche, “Performance evaluation of routing protocols for ad hoc wireless networks”, Vol.9, No.4, pp.333-342, 2004.

[24] B.R.A. Kumar, L.C. Reddy, and P.S. Hiremath, “Performance comparison of wireless mobile ad-hoc network routing protocols”, International Journal of Computer Science and Network Security, Vol. 8, No.6, pp. 337-343, 2008.

[25] N. Qasim, F. Said, and H. Aghvami, “Performance Comparison of Mobile ad-hoc network routing protocols”, IAENG International Journal of Computer Science, Vol.36, No.1, pp.76-84, 2009.

https://sites.google.com/site/ijcsis/
ISSN 1947-5500