ROUTING PROTOCOLS PERFORMANCE EVALUATION BASED ON FTP AND CBR APPLICATION AGENTS FOR WIRELESS NETWORKS

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Abstract—The wireless networks usually form a network among wireless nodes without any central administration. The key objective is decided for this research work is to study and investigate the performance of reactive kind of routing protocols like AODV,AOMDV, DSDV and DSR routing protocols. The design of efficient routing protocols is crucial for such wireless network since they wireless nodes have limited battery power and they cannot be recharged whenever needed. In This paper all these four protocols performance is compared based on Constant bit Rate (CBR) application with TCP agent and File transfer protocol (FTP) application with UDP agent with wireless node ranging from 50 nodes to 150 nodes. The Network Simulator 2 (NS-2.35) is used as simulation tool and Packet delivery ratio, packet loss ratio and E-2-E delay is considered as network parameters.

Index Terms- CBR, TCP, protocols, AODV, AOMDV, DSR DSDV, wireless networks, NS-2.

I. INTRODUCTION

Wireless networks consist of wireless nodes in which communication is established without any centralized infrastructure or any centralized control. The communication among wireless nodes is established using multi-hop routing. In such networks, the performance of network changes and degraded when nodes starts moving arbitrarily in any direction. A wireless ad hoc network is self-organizing, self disciplining, and self-adaptive in nature.

A wireless network consists of mobile hosts equipped with wireless communication devices. The transmission of a mobile host is received by all hosts within its transmission range due to the broadcast nature of wireless communication and Omni-directional antenna [1][2][3]. Each host needs to be equipped with the capability of an autonomous system, or a routing function without any statically established infrastructure or centralized administration due to the mobility of wireless hosts. If two wireless hosts are out of their transmission ranges in the wireless networks, other mobile hosts located between them can forward their messages, which effectively build connected networks among the mobile hosts in the deployed area in other words; they acts as a router. The mobile hosts can move arbitrarily and can be turned on or off without notifying other hosts. The mobile host mobility and autonomy introduces a dynamic topology of the networks not only because end hosts are transient but also because intermediate hosts on a communication path are transient [1][2][3]. The communication between the nodes in a packet data network must be defined to ensure correct interpretation of the packets by receiving intermediate and end systems. And the routing involves two things: Firstly determining optimal routing paths, secondly transferring the information groups (called packets) through an internetwork. Routing protocols use several metrics to calculate the best path for routing the packets to its destination. Unsurprisingly, designing good protocols with few packets collision will reduce power consumption. At the network layer, the routing protocols can be designed such that there is an increase in the network life time by distributes the forwarding load over multiple different paths.

Since the nodes are mobile, the network topology may change quickly and cannot be predicted over time. The main characteristics of ad hoc networks are as follows:

Dynamic topology: Because nodes in the network can move arbitrarily, the topology of the network also changes.

The bandwidth of the link: it is unstrained, and the capacity of the network is also tremendously variable. Because of the dynamic topology, the output of each relay node will vary with the time, and then the link capacity will change with the link change. At the same time, collision and interference make the actual bandwidth of ad hoc networks smaller than their bandwidth in theory.

Power limitation: it is in mobile devices is a serious factor. Because of the mobility characteristics of the network, devices use batteries as their power supply. As a result, advanced power conservation techniques are very necessary in designing a system.

The Safety: it is limited in a physical aspect. The mobile network is more easily attacked than the fixed network. Overcoming the weakness in safety and the new safety trouble in wireless networks are on demand. Each and every node has limited life spam. To maximize the life time of nodes in a network, the energy consumption rate of each node must be evenly distributed. Section II describes the Theoretical concept of Routing Protocols, Section III presents simulation environment, and Section IV presents results and graphs and lastly section V gives the conclusion.

II. ROUTING PROTOCOLS

(1) AODV Routing Protocol: Ad-hoc On-Demand Distance Vector is based on the Bellmann-Ford distant vector algorithm for ad-hoc networks. When a node needs to send a packet to a destination, AODV uses a mechanism of Route Discovery to built a route. It uses also a Route Maintenance for errors. Route Discovery consists of RREQ (Request) and RREP (Reply) when a node would like to send a packet. Route Maintenance consists of RERR messages, HELLO messages and precursor lists. Sequence numbers provide fresh routes and avoid routing loops. All nodes monitor their own neighbors. When a node, in an active route, gets lost, a route error message (RERR) is sent to

notify the link lost. Nodes use a HELLO message to inform only neighbours that the link is still alive. When a node receives a HELLO message it refreshes its lifetime from the neighbour information in the routing table.

(2) AOMDV Routing Protocol: The Ad Hoc On-demand Multipath Distance Vector Routing is a improvement of AODV. Contrary to AODV, AOMDV discovers multiple paths between the source and the destination during the route discovery operation. It is more efficient for highly dynamic ad hoc networks since errors occur frequently. The AOMDV protocol has two main principles: _ a route update rule to establish and maintain multiple loopfree paths at each node. _ a distributed protocol to find link-disjoint paths. Multipath routing protocols, such as AOMDV, try to reduce the high latency of route discovery which can decrease performances.

(3) DSR Routing Protocol: Dynamic Source Routing (DSR) is a reactive protocol such as AODV and AOMDV. It is similar to the AODV protocol which creates a route on-demand when a node needs to send to a destination. However, contrary to AODV, DSR uses source routing. DSR accumulates the address of each node between the source and the destination. This path information is coached by nodes processing the route discovery packets. With this routing protocol, each node contains the address of each intermediate node. That results in high overhead for high dynamic networks. The main disadvantage of this protocol is that a broken link is not locally repaired by the route maintenance mechanism. The connection setup delay is higher than in table driven protocols. In static and low mobility, DSR behaves with high efficiency. But due to source-routing, routing overhead increases when mobility and path length increase too, so performance decreases quickly.

(4) DSDV Routing Protocol: DSDV is an improved routing protocol of the distributed Bellman-Ford routing algorithm. In this protocol, a table consisting of the shortest distance and the starting node of the shortest path is maintained at every node. Table updates are done with the increasing sequence number provided so as to, i. Prevent loops ii. Provide a faster convergence iii. Avoid the count-to-infinity problem. Every node in the table-driven routing protocol has route to destination. The routing table is exchanged periodically between the neighboring nodes, so that an up-to-date view of the topology is maintained. If a node sees a change in the network topology, then also the table is forwarded to its neighbor.

Musica Supriya et. Al. [12] analysed different MANET routing protocols on the basis of different performance metrics such as packet delivery ratio, transmission delay and path length. For table-driven protocol the throughput was found to be high as each node maintains the table.

Rakesh Kumar Jha et. Al [13] compared OLSR with AODV and DSDV protocols and observed that OLSR protocol gives best result on the basis of Packet delivery ratio, packet dropped, jitter and end to end delay. As far as throughput is considered, the performance of AODV protocol is better for the network with varying number of nodes.

Pallavi S. Katkar et. Al [14] observed that AODV provides better throughput compare to DSDV and OLSR. In AODV rerouting is less so gives better PDR than DSDV. In AODV routs are determined on demand basis and hence its delay is more than other two protocols. DSDV is table driven protocol so needs time to routing table setup and provides less throughput and PDR. Proactive routing protocols are having minimum delay because of already stored routing information in routing table hence reduces its delay. DSDV is the proactive protocol and its delay is less. OLSR is a better option than DSDV, provides better PDR and lowest delay.

JogendraKumar et. Al. [15] compared the various wireless routing protocols; Ad-hoc On demand Distance Vector, Dynamic Source Routing, Dynamic MANET on demand Routing and Zone Routing Protocol in ad-hoc networks. The performances analysis and evaluation was done on performance metrics such as Average Jitter, Throughput, Average End to End delay, Packet Delivery Ratio on CBR traffic load. The simulation work was done by Qualnet 5.0.2 simulator tools.

Vijeta Kumawat et. Al. [16] concluded that proactive routing protocol such as DSDV and OLSR, each node maintains up-to-date routing information in the network. So connection setup times are fast and end to end delay is less than AODV but these routing protocols have large amount of routing overhead due to frequent update message in network. On demand routing protocol such AODV reduces the traffic in network but introduces delay due to route discovery process on demand and AODV routing protocol is achieved highest PDR compared to OLSR and DSDV so it is highly adaptable in WSN.

Er. Vani Malagar et. Al. [17] highlighted the comparative Analysis of the protocols under each of the classes, dissemination technique, maintenance of the route, delay of packets and the area suitable for routing. Although, a significant number of these routing protocols look encouraging, there are as yet many difficulties that should be explained in vehicular Ad-Hoc network.

J. Kaur et. Al. [18] analyzed the performance of AODV, DSR and DSDV routing protocol in terms of PDR, end-to-end delay and packet loss. To propose improvement in protocol this is higher performance for path establishment between source and destination. To improve the quality of service based multipath routing in Mobile Ad hoc Networks (MANETs) based on Ant Colony Optimizations (ACO) look-ahead approach.

Dr. Ajay Jangra et. Al. [19], IoT and its technical challenges has been discussed. After that comparison between different routing protocols with different performance parameters has been presented. Comparative analysis shows that AODV and is best suited routing protocols for IoT data transmission.

III. SIMULATION ENVIRONMENT

The routing protocols are analyzed with the object oriented discrete event simulator NS-2. In simulation, 50-100-150 mobile nodes move in a 1000 m x 1000 m square region for 200 seconds simulation time. The Simulator Environment is created by using TCL Script with the help of following parameters included in the table. In the TCL script use the two types of Applications those are FTP (File Transfer Protocol) with TCP Agent and CBR (Constant Bit Rate) with UDP agent.

Following figures 1 and 2 shows the simulation snapshot of nodes deployed in NS-2.

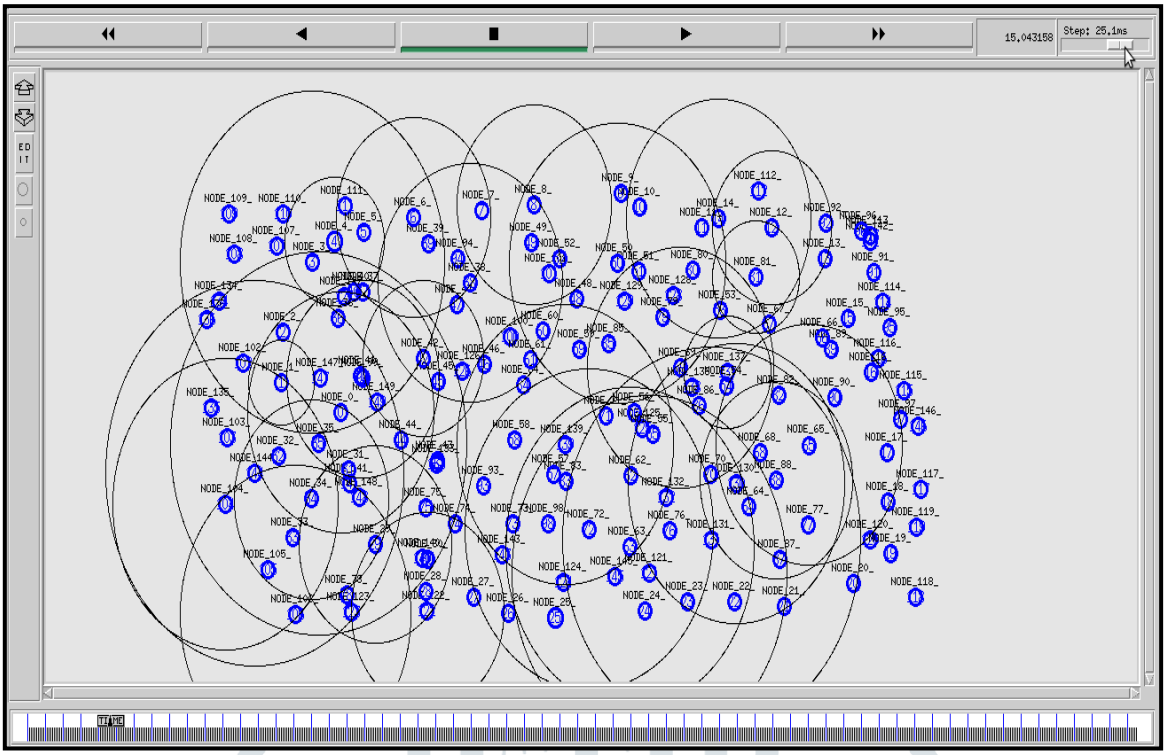


Figure 1: Network Animator (NAM) Snapshot

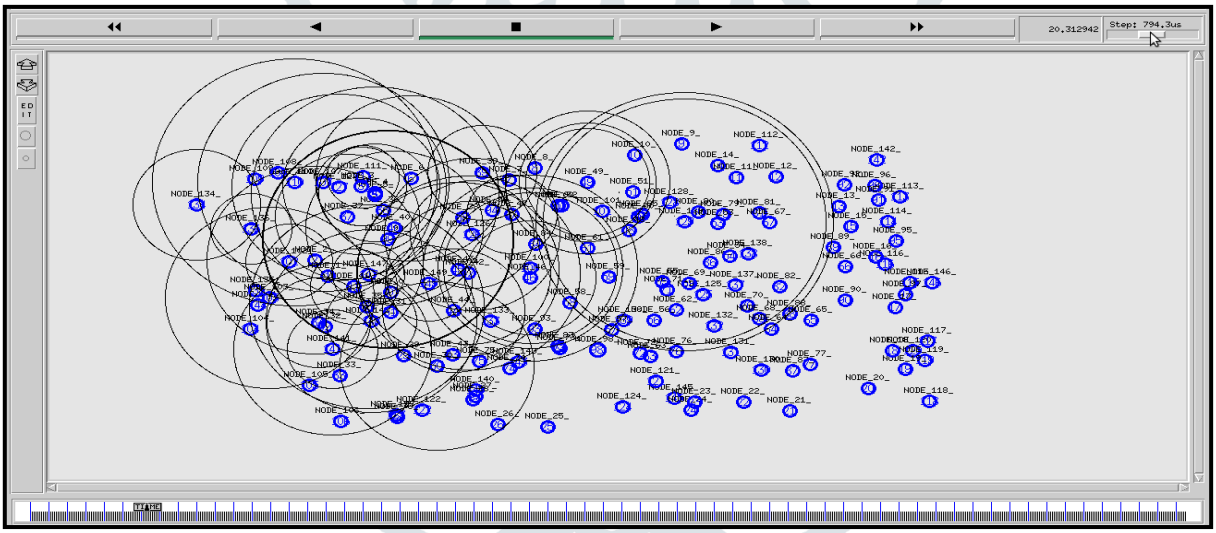


Figure 2: Nodes Comunication

The Table 1 shows the Simulation Environment parameters.

Table 1: Simulation parameters

Parameter	Value
Protocols	AODV,AOMDV,DSDV,DSR
Simulation Area	1000m x 1000m
Packet Size	512 bytes
Simulation Time	200 seconds
Pause Time	20 seconds
Speed	10m/s, 20m/s,30m/s,40m/s,50m/s
Number of Nodes	50,100,150
Traffic Generation	TCP with FTP, UDP with CBR
Mobility Model	Random Waypoint
Network Simulator	NS-2.35

IV. RESULTS AND GRAPHS

4.1 UDP with CBR Analysis

Constant Bit Rate is an encoding method that keeps the bit rate same as opposed to VBR which varies the bit rate. CBR processes audio faster than VBR due to its fixed bit rate value. The downside to a fixed bit rate is that the files that are produced are not as optimized for quality vs. storage as VBR. For example, if there is a quiet section in a music track that does not require the full bit rate to produce good quality sound then CBR will still use the same value thus wasting storage space. The same is true for a complex sounds, if the bit rate is too low then quality will suffer [6][4][5].

In this section the performance of AODV, AOMDV, DSDV and DSR protocols have been discussed with UDP transport layer protocols with CBR application layer protocol.

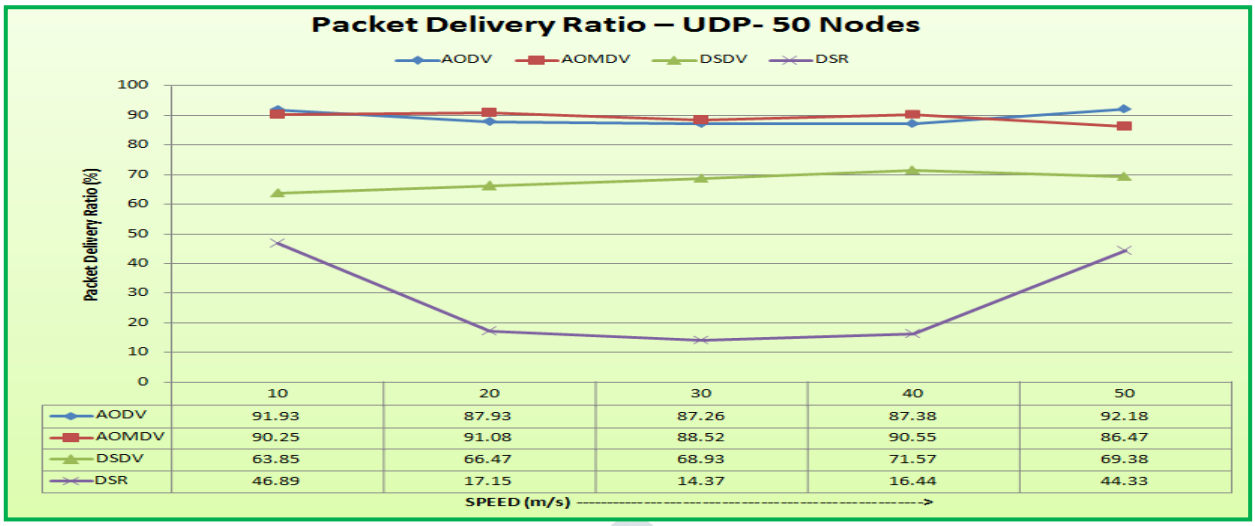


Figure 3 shows that packet delivery ratio (PDR) for AODV and AOMDV routing protocols are nearly same. DSDV shows moderate PDR ratio while DSR protocol has lowest PDR ratio. So, AOMDV or AODV routing protocol may be best suited for CBR application with 50 nodes.

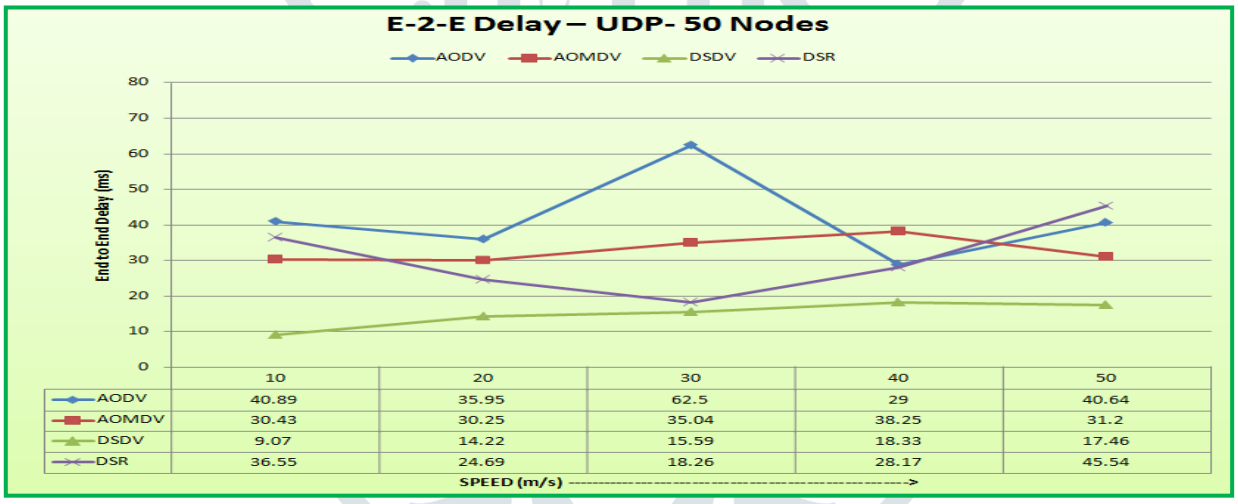


Figure 4 shows that end to end (E-2-E) delay for AODV and DSR routing protocols are nearly same. AOMDV shows moderate E-2-E delay while DSDV protocol has lowest E-2-E delay value. So, DSDV routing protocol may be best suited for CBR application with 50 nodes in respect of delay concern.

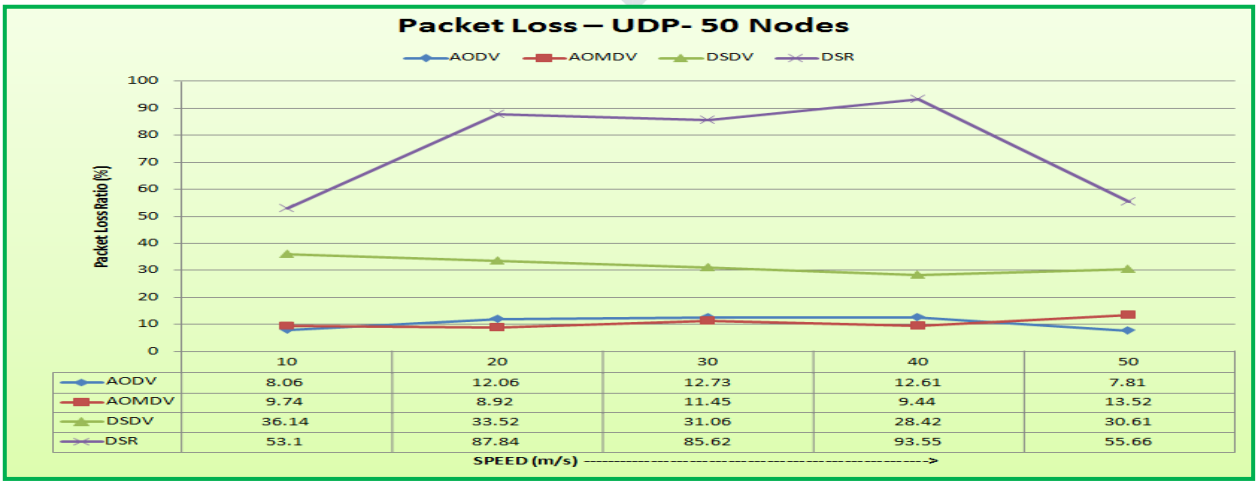


Figure 5 shows that packet loss ratio (PLR) for AODV and AOMDV routing protocols are nearly same. DSDV shows moderate PLR ratio while DSR protocol has highest PLR ratio. So, AOMDV or AODV routing protocol may be best suited for CBR application with 50 nodes in respect of packet loss ratio concern.

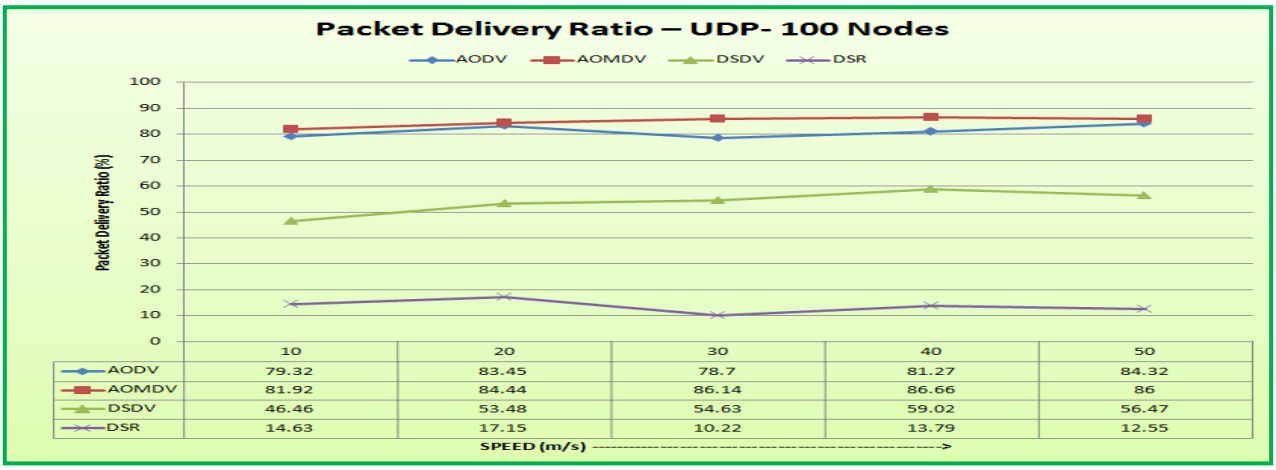


Figure 6: PDR graph for UDP 100 nodes

Figure 6 shows that packet delivery ratio (PDR) for AODV and AOMDV routing protocols are nearly same. DSDV shows moderate PDR ratio while DSR protocol has lowest PDR ratio. So, AOMDV or AODV routing protocol may be best suited for CBR application with 100 nodes in respect of packet delivery ratio concern.

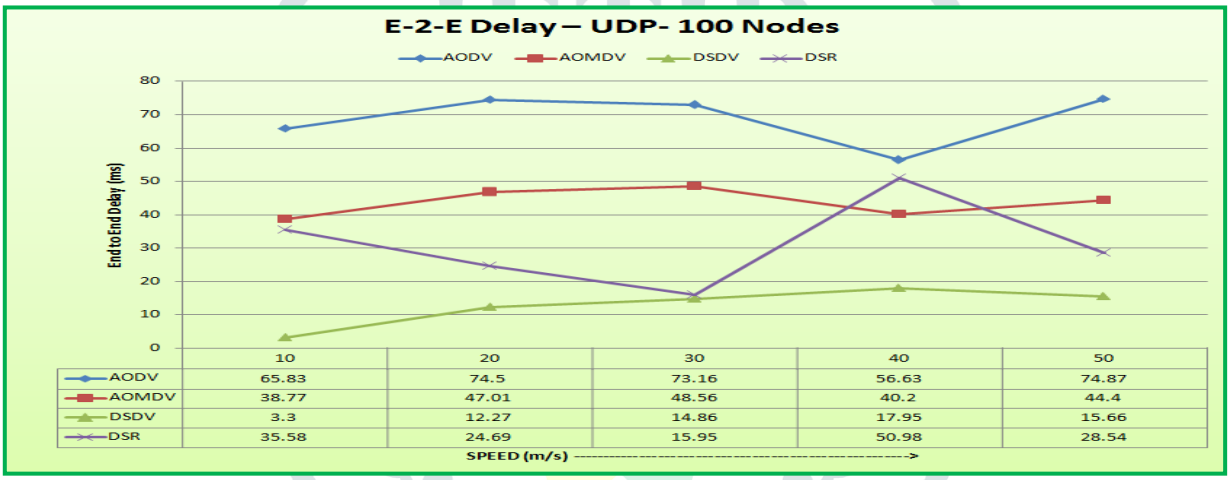


Figure 7: E-2-E graph for UDP 100 nodes

Figure 7 shows that end to end (E-2-E) delay for AODV and AOMDV routing protocols are nearly same. DSR shows moderate E-2-E delay while DSDV protocol has lowest E-2-E delay value. So, DSDV routing protocol may be best suited for CBR application with 100 nodes in respect of delay concern.

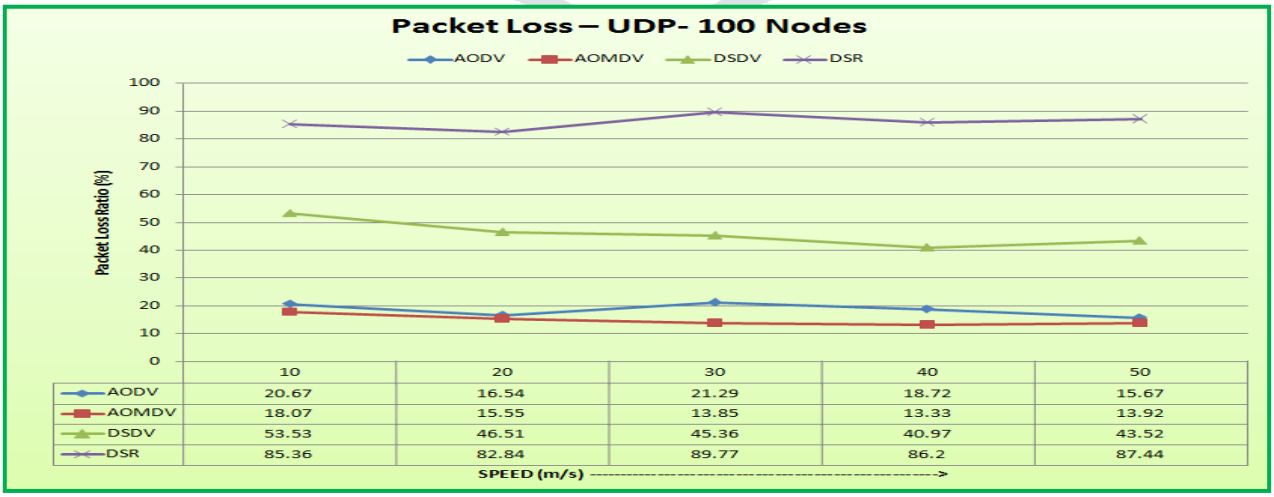


Figure 8: PLR graph for UDP 100 nodes

Figure 8 shows that packet loss ratio (PLR) for AODV and AOMDV routing protocols are nearly same. DSDV shows moderate PLR ratio while DSR protocol has highest PLR ratio. So, AOMDV or AODV routing protocol may be best suited for CBR application with 100 nodes in respect of packet loss ratio concern.

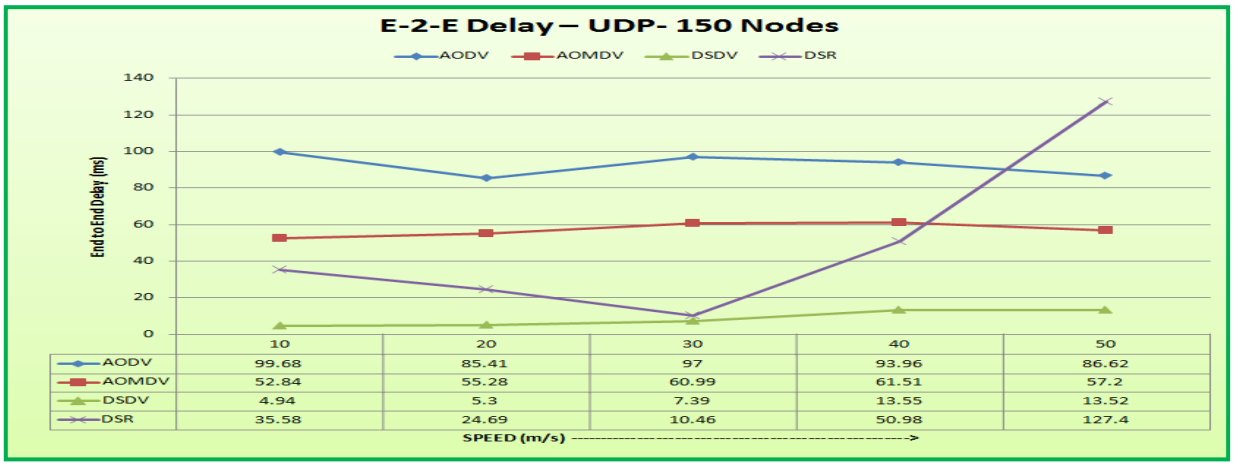


Figure 9: E-2-E delay graph for UDP 150 nodes

Figure 9 shows that end to end (E-2-E) delay for AODV and AOMDV routing protocols are nearly same. DSR shows moderate E-2-E delay while DSDV protocol has lowest E-2-E delay value. So, DSDV routing protocol may be best suited for CBR application with 150 nodes in respect of delay concern.

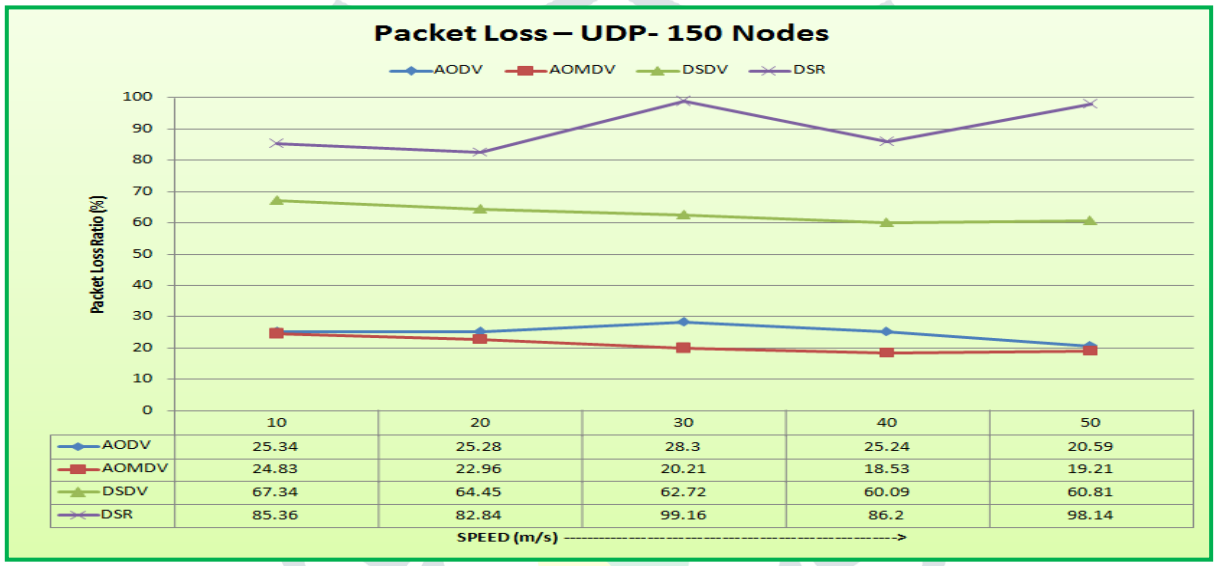


Figure 10: PLR graph for UDP 150 nodes

Figure 10 shows that packet loss ratio (PLR) for AODV and AOMDV routing protocols are nearly same. DSDV shows moderate PLR ratio while DSR protocol has highest PLR ratio. So, AOMDV or AODV routing protocol may be best suited for CBR application with 150 nodes in respect of packet loss ratio concern.

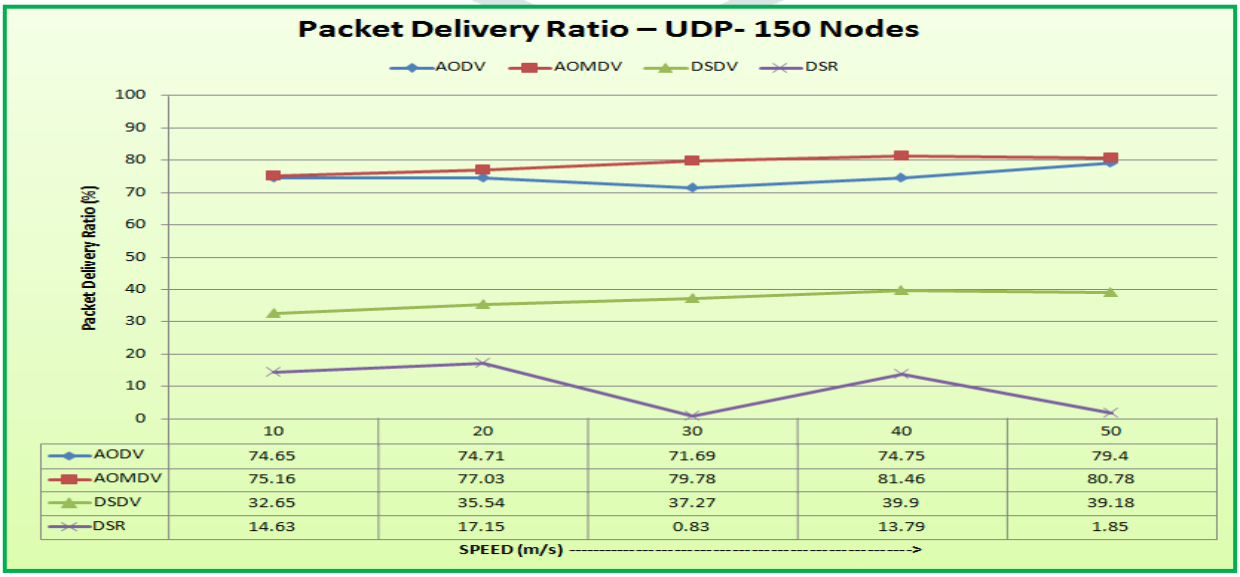


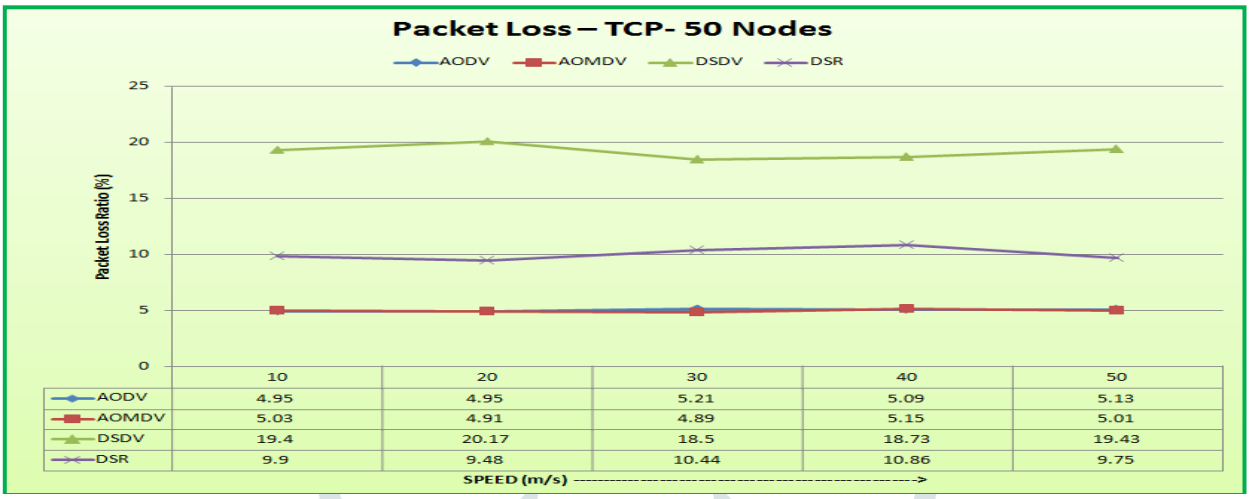
Figure 11: PDR graph for UDP 150 nodes

Figure 11 shows that packet delivery ratio (PDR) for AODV and AOMDV routing protocols are nearly same. DSDV shows moderate PDR ratio while DSR protocol has lowest PDR ratio. So, AOMDV or AODV routing protocol may be best suited for CBR application with 150 nodes in respect of packet delivery ratio concern.

4.2 TCP with FTP Analysis

File Transfer Protocol (FTP) is a standard Internet protocol for transmitting files between computers on the Internet. Like the Hypertext Transfer Protocol (HTTP), which transfers displayable Web pages and related files, and the Simple Mail Transfer Protocol (SMTP), which transfers email, FTP is an application protocol that uses the Internet's TCP/IP protocols. FTP is commonly used to transfer Web page files from their creator to the computer that acts as their server for everyone on the Internet. It's also commonly used to download programs and other files to your computer from other servers [6][4][5].

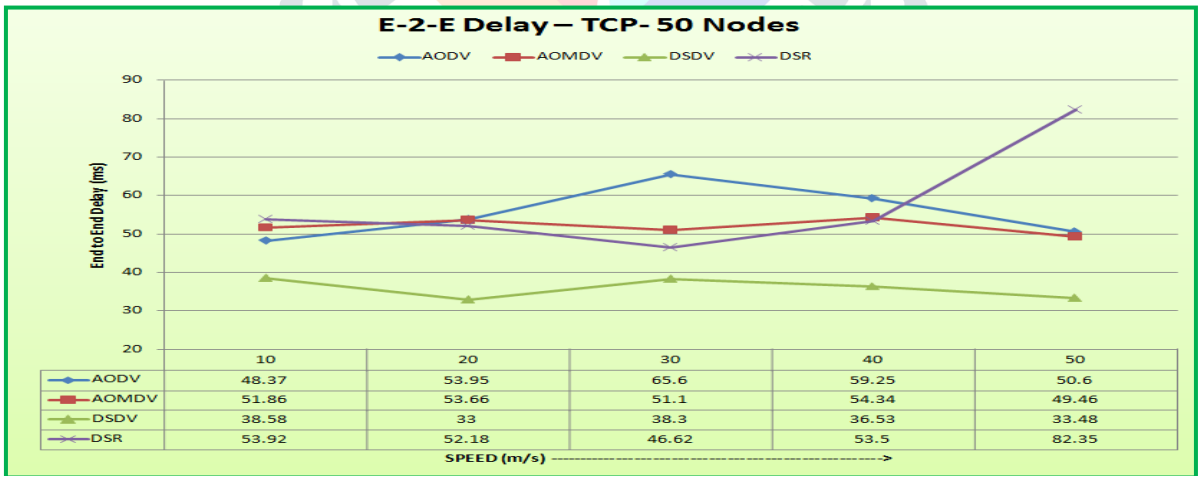
In this section the performance of AODV, AOMDV, DSDV and DSR protocols have been discussed with TCP transport layer protocols with FTP application layer protocol.



	10	20	30	40	50
AODV	4.95	4.95	5.21	5.09	5.13
AOMDV	5.03	4.91	4.89	5.15	5.01
DSDV	19.4	20.17	18.5	18.73	19.43
DSR	9.9	9.48	10.44	10.86	9.75

Figure 12: PLR graph for TCP 50 nodes

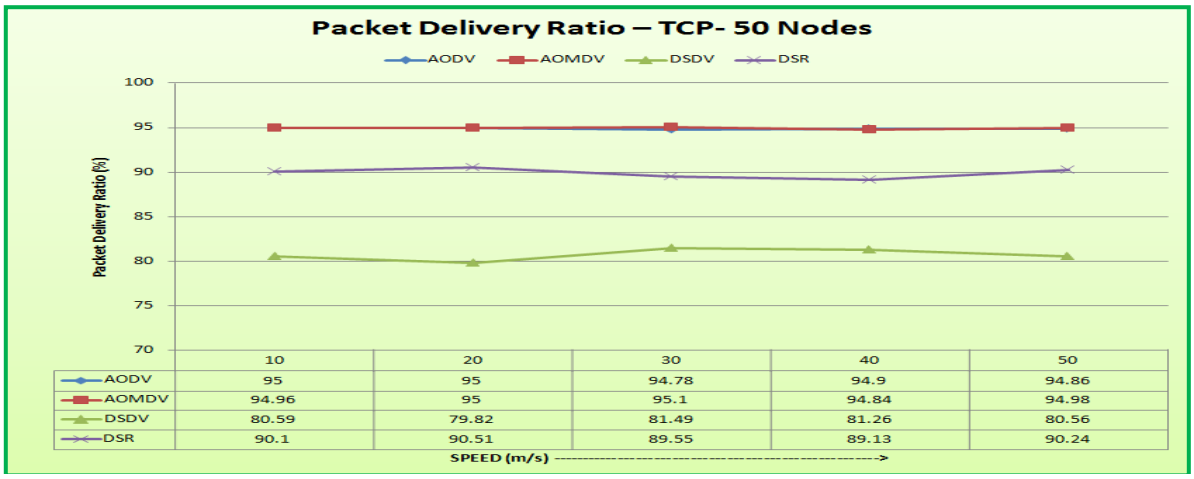
Figure 12 shows that packet loss ratio (PLR) for AODV and AOMDV routing protocols are nearly same. DSR shows moderate PLR ratio while DSDV protocol has highest PLR ratio. So, AOMDV or AODV routing protocol may be best suited for FTP application with 50 nodes in respect of packet loss ratio concern.



	10	20	30	40	50
AODV	48.37	53.95	65.6	59.25	50.6
AOMDV	51.86	53.66	51.1	54.34	49.46
DSDV	38.58	33	38.3	36.53	33.48
DSR	53.92	52.18	46.62	53.5	82.35

Figure 13: E-2-E delay graph for TCP 50 nodes

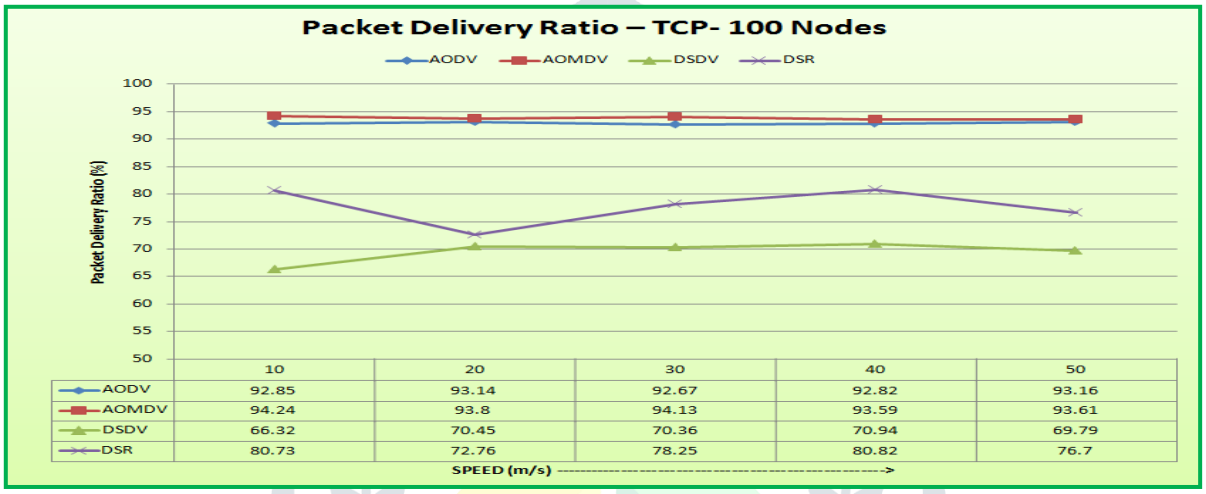
Figure 13 shows that end to end (E-2-E) delay for AODV and AOMDV routing protocols are nearly same. DSR shows moderate E-2-E delay while DSDV protocol has lowest E-2-E delay value. So, DSDV routing protocol may be best suited for FTP application with 50 nodes in respect of delay concern.



	10	20	30	40	50
AODV	95	95	94.78	94.9	94.86
AOMDV	94.96	95	95.1	94.84	94.98
DSDV	80.59	79.82	81.49	81.26	80.56
DSR	90.1	90.51	89.55	89.13	90.24

Figure 14: PDR graph for TCP 50 nodes

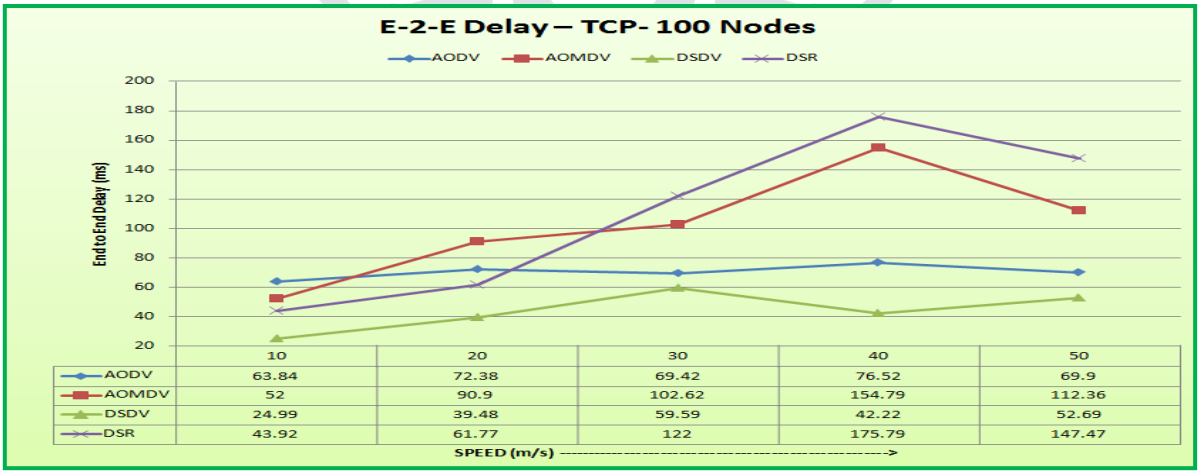
Figure 14 shows that packet delivery ratio (PDR) for AODV and AOMDV routing protocols are nearly same. DSR shows moderate PDR ratio while DSDV protocol has lowest PDR ratio. So, AOMDV or AODV routing protocol may be best suited for FTP application with 50 nodes in respect of packet delivery ratio concern.



	10	20	30	40	50
AODV	92.85	93.14	92.67	92.82	93.16
AOMDV	94.24	93.8	94.13	93.59	93.61
DSDV	66.32	70.45	70.36	70.94	69.79
DSR	80.73	72.76	78.25	80.82	76.7

Figure 15: PDR graph for TCP 100 nodes

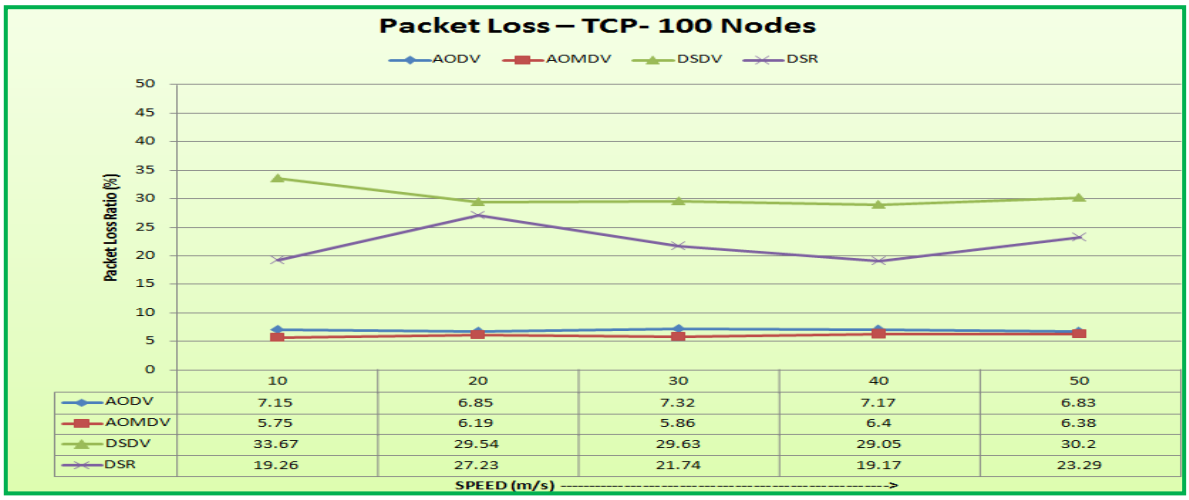
Figure 15 shows that packet delivery ratio (PDR) for AODV and AOMDV routing protocols are nearly same. DSR shows moderate PDR ratio while DSDV protocol has lowest PDR ratio. So, AOMDV or AODV routing protocol may be best suited for FTP application with 100 nodes in respect of packet delivery ratio concern.



	10	20	30	40	50
AODV	63.84	72.38	69.42	76.52	69.9
AOMDV	52	90.9	102.62	154.79	112.36
DSDV	24.99	39.48	59.59	42.22	52.69
DSR	43.92	61.77	122	175.79	147.47

Figure 16: E-2-E delay graph for TCP 100 nodes

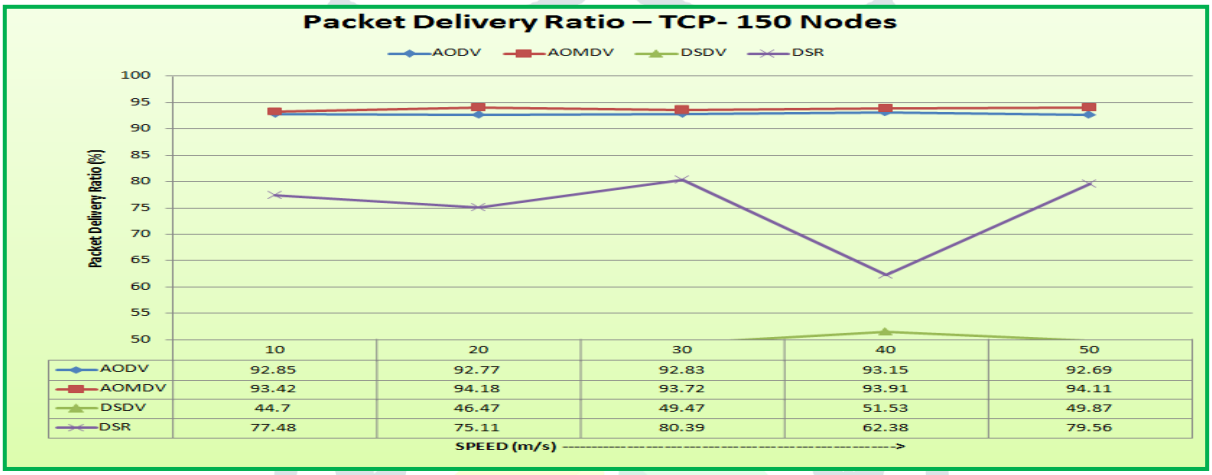
Figure 16 shows that end to end (E-2-E) delay for DSDV and AODV routing protocols are nearly same. AOMDV shows moderate E-2-E delay while DSR protocol has highest E-2-E delay value. So, DSDV routing protocol may be best suited for FTP application with 100 nodes in respect of delay concern.



	10	20	30	40	50
AODV	7.15	6.85	7.32	7.17	6.83
AOMDV	5.75	6.19	5.86	6.4	6.38
DSDV	33.67	29.54	29.63	29.05	30.2
DSR	19.26	27.23	21.74	19.17	23.29

Figure 17: PLR graph for TCP 100 nodes

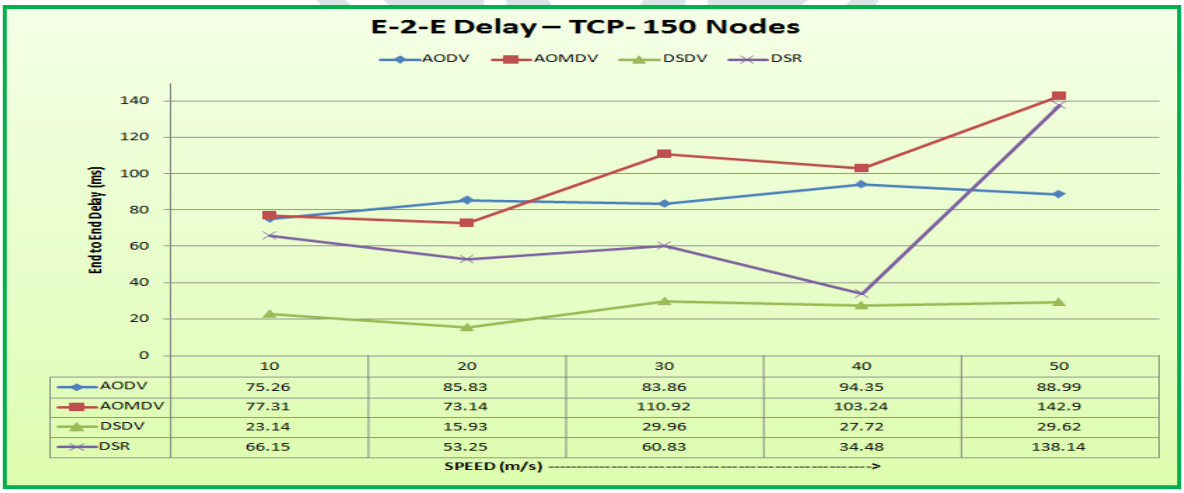
Figure 17 shows that packet loss ratio (PLR) for AODV and AOMDV routing protocols are nearly same. DSR shows moderate PLR ratio while DSDV protocol has highest PLR ratio. So, AOMDV or AODV routing protocol may be best suited for FTP application with 100 nodes in respect of packet loss ratio concern.



	10	20	30	40	50
AODV	92.85	92.77	92.83	93.15	92.69
AOMDV	93.42	94.18	93.72	93.91	94.11
DSDV	44.7	46.47	49.47	51.53	49.87
DSR	77.48	75.11	80.39	62.38	79.56

Figure 18: PDR graph for TCP 150 nodes

Figure 18 shows that packet delivery ratio (PDR) for AODV and AOMDV routing protocols are nearly same. DSR shows moderate PDR ratio while DSDV protocol has lowest PDR ratio. So, AOMDV or AODV routing protocol may be best suited for FTP application with 150 nodes in respect of packet delivery ratio concern.



	10	20	30	40	50
AODV	75.26	85.83	83.86	94.35	88.99
AOMDV	77.31	73.14	110.92	103.24	142.9
DSDV	23.14	15.93	29.96	27.72	29.62
DSR	66.15	53.25	60.83	34.48	138.14

Figure 19: E-2-E delay graph for TCP 150 nodes

Figure 19 shows that end to end (E-2-E) delay for AODV and AOMDV routing protocols are nearly same. DSR shows moderate E-2-E delay while DSDV protocol has lowest E-2-E delay value. So, AODV or AOMDV routing protocol may be best suited for FTP application with 150 nodes in respect of delay concern.

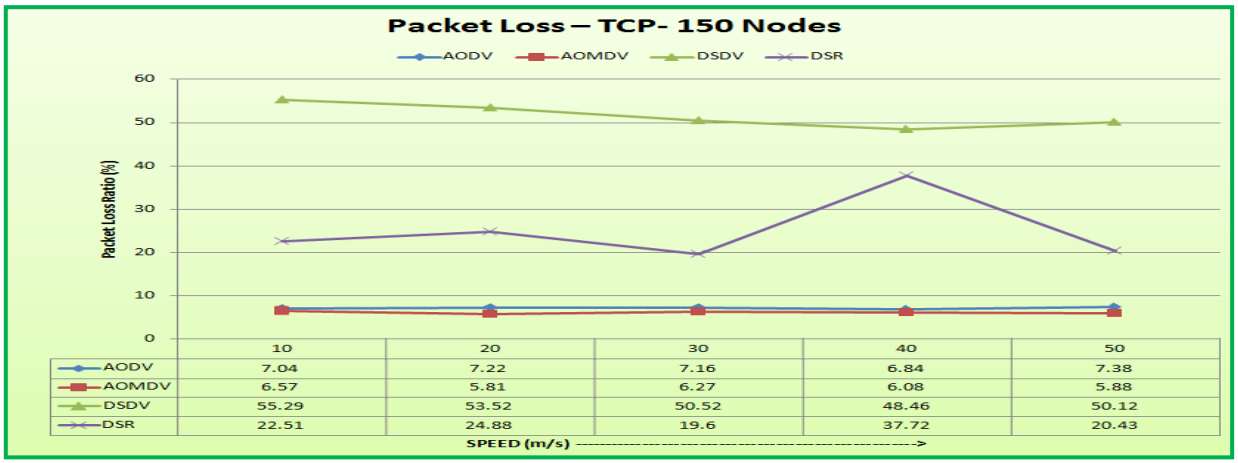


Figure 20: PLR graph for TCP 150 nodes

Figure 20 shows that packet loss ratio (PLR) for AODV and AOMDV routing protocols are nearly same. DSR shows moderate PLR ratio while DSDV protocol has highest PLR ratio. So, AOMDV or AODV routing protocol may be best suited for FTP application with 150 nodes in respect of packet loss ratio concern.

V. CONCLUSION

Generally in wireless networks the design of Routing protocols is very important criteria because the performance of network depends on the design of routing protocols. The key objective is decided for this research work is to study and investigate the performance of reactive kind of routing protocols like AODV,AOMDV, DSDV and DSR routing protocols. The design of efficient routing protocols is crucial for such wireless network since they wireless nodes have limited battery power and they cannot be recharged whenever needed. In This paper all these four protocols performance is compared based on Constant bit Rate (CBR) application with TCP agent and File transfer protocol (FTP) application with UDP agent with wireless node ranging from 50 nodes to 150 nodes. The conclusion of this work can be concluded with the following table 2.

Table 2: Comparison of Routing Protocols

Protocol	Packet Delivery Ratio		Packet Loss Ratio		End to End Delay	
	FTP	CBR	FTP	CBR	FTP	CBR
AODV	HIGH	HIGH	LOW	LOW	AVG.	HIGH
AOMDV	HIGH	HIGH	LOW	LOW	AVG.	AVG.
DSDV	LOW	AVG.	HIGH	AVG.	LOW	LOW
DSR	AVG.	LOW	AVG.	HIGH	HIGH	AVG.

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