# Analysis and Simulation of UDP-based application for Wireless Network

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## ABSTRACT
Wireless technology is rapidly gaining in popularity for educational institutes, home and business networking. As the wireless technology continues to improve the cost of wireless products continues to decrease. Wireless networks utilize radio waves and/or microwaves to maintain communication channels between computers. There various popular routing protocols available for wireless networks are DSDV, AODV and DSR. This paper is aimed at dissemination of the measuring performance i.e., throughput, packet drop rate and average packet end-to end delay of wireless network UPD-based application for various routing protocol using simulation framework for video transmission over the wireless network in Fedora environment.

Keywords: NS2, VoD. VoIP, Video Transmission, WNs et. al.

## General Terms
Multimedia Communication, Video over IP, Network Simulator, Wireless Network communication et. al.

## 1. INTRODUCTION
The video transmission over wireless network is commonly today's requirement of each laptop, palmtop, mobile users. Without compression it is very difficult to transmit video over wired or wireless network because video content requires very large network bandwidth. For instance, 720p video at 60 frames/s using 10 b/colour requires about 1.4 Gb/s.

To transmit the content over bandwidth- limited media like wireless IEEE 802.11, the content (even real-time content) needs to be compressed. This paper gives about measuring performance evaluation matrices of routing protocol for video transmission over wireless network using simulation framework for video transmission over the wireless network in Fedora environment [1]. There are various routing protocol used in wireless network. We consider main three routing protocol in our research are: DSDV, AODV and DSR. The eight wireless mobile nodes simulation topology shown in figure 1.

## 2. ROUTING PROTOCL
Routing algorithm decide the path (route) of the packets over wireless network. These are categories in two parts, first source initiated (on demand driven) and second table driven [2].

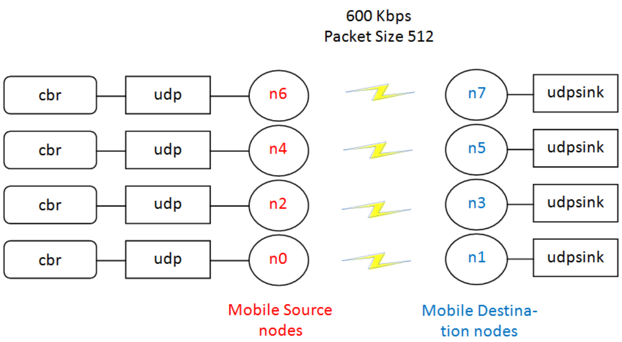


**Fig. 1**: Eight Wireless Mobile nodes Simulation Topology

We chose most popular three routing protocols: Ad Hoc On-demand Distance-Vector Protocol (AODV), Destination Sequenced Distance-Vector (DSDV) and Destination Source Routing (DSR) for our research work [3][4][5].

### 2.1 Ad Hoc On-demand Distance-Vector Protocol (AODV)
The AODV routing algorithm is a routing protocol designed for ad hoc mobile networks. It is capable of both unicast and multicast routing. It is an on-demand driven type of algorithm, meaning that it builds routes between nodes only as required by the source nodes. It maintains these routes as long as they are needed by the sources. Additionally, it forms trees which connect multicast group members. These trees are composed of the group members and the nodes needed to connect the members. It uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes. It builds routes using a route request and route reply query cycle. When a source node requires a route to a destination for which it does not already have a route in its tree, it broadcasts a route request (RREQ) packet across the network. Whenever a any node receiving this packet update their information for the source node and set up backwards pointers to the source node in its route tables. In addition to that the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. Any node receiving the RREQ packet may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ packet. If this is the case, it unicasts a RREP packet back to the source. Otherwise, it rebroadcasts the RREQ packet. Nodes keep track of the RREQ packet's source IP address and broadcast ID. If

they receive a RREQ packet which they have already processed, they discard the RREQ packet and do not forward it [5][6].

As the RREP packet propagates back to the source, that node set up forward pointers to the destination. Once the source node receives the RREP packet, it may begin to forward data packets to the destination. If the source later receives a RREP packet containing a greater sequence number or contains the same sequence number with a smaller hop-count, it may modify its routing information in routing table for that destination and begin using the better route for future.

As long as the route remains active, it will continue to be maintained in root table. A route is considered active or live as long as there are data packets periodically travelling between the source to the destination along that path. Once the source stops sending data packets, the link will be deleted from the intermediate node routing tables. If a link break down occurs while the route is live, the node upstream of the break propagates a route error (RERR) message to the source node to alert it of the now unreachable destination(s). After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

AODV uses the following fields in each route table entry:

- Destination IP Address
- Destination Sequence Number
- Valid Destination Sequence Number flag
- Other state and routing flags (e.g., valid, invalid, repairable, being repaired)
- Network Interface information
- Hop Count number (number of hops required to reach up to destination)
- Next Hop IP address
- List of Precursors Hops
- Lifetime (expiration or deletion time of a route)

## 2.2 Destination Sequenced Distance-Vector (DSDV)

This algorithm is based on the traditional Bellman-Ford routing algorithms developed by the improvement in routing table based protocol. Each wireless node entry must be stored and constantly updated in the adjacent node routing table, each node will time to time enter its entry to the routing table of their closest neighbors send in order to retain the integrity of all nodes [5][6].

It is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. The main involvement of the algorithm was to solve the Routing Loop problem. Each entry in the routing table covers a sequence number, the sequence numbers are usually even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Nodes routing information is spread between nodes by sending full dumps rarely and smaller incremental updates more frequently.

Each node maintains a list of all destinations nodes and number of hops to each destination node. Each entry is marked with a sequence number. It uses full dump or incremental packets to decrease network traffic produced by route information updates. The transmission of route update is delayed by settling time. The only improvement made here is prevention of routing loops in a mobile network of routers. With this upgrading, routing information can always be readily accessible, irrespective of whether the source node needs route or not.

## 2.3 Destination Source Routing (DSR)

This algorithm is based on the concept of source routing. In this protocol, mobile nodes are required to maintain route caches that contain the source routes of which the mobile node is aware. Entries in the route cache are continually updated as new routes are learned. There are 2 major phases of the protocol - route discovery and route kept route discovery uses route request and route reply packets. Route maintenance uses route error packets and acknowledgements [5][6].

*A. Route discovery*

While working on with this algorithm, in order to determine the destination address, source node broadcasts a route request (RREQ) packet. When each host receives this packet checks for the packet delicacy and if found than host discards the packet. Otherwise, it looks up its route caches to look for a route to the destination. If route is not found, it appends its address into the packet and rebroadcasts it. If the route is found, it unicasts a route reply packet to the source node. The route will be finally found when the route request packet reaches the destination node.

*B. Route Maintenance*

If any two nodes listed next to each other in the route of the packet transmission identified in the packet header, moves out of range, then a route error message to send back to the sender. The Sender on receiving it can either use another route in its cache or invoke Route Discovery Again.

# 3. PERFORMANCE EVALUATION METRICS

In wireless network there are various performance evaluation metrics are available. We chose most popular three metrics: throughput, packet drop rate and average packet end-to end delay [3][4].

## 3.1 Throughput

In communication networks, such as Ethernet or packet radio, throughput or network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

## 3.2 Packet drop rate

When a receiver processes UDP packets, it has no way of knowing whether there are missing packets. It just processes what it has. As this situation applies to say general-purpose VoIP and video over wireless, it is nothing more than a irritation. The loss of a single packet might not even be detected by the listener/viewer as our senses have the ability to “fill in” audible and visual sources to some extent. A string of dropped packets usually results in the unavoidable.

With video over wireless, we have a similar situation; our eyes can ignore or fill in for a momentary “glitch” in the video. With video, however, even the loss of a single packet can cause a more significant degradation than with VoIP. Because of the vast amount of data required to represent full motion video at approximately 30 frames per second, nearly every video transport will use data compression (e.g. MPEG4) to reduce the stream to a more manageable level. A common approach is to use a "key frame" that contains complete video information followed by a number of frames that communicate only the modifications to that key frame (and are thus less data intensive). For manufacturers, wireless with a high degree of packet loss is of no value because they have no way of telling whether the error is in their source files or in the network that they are using.

## 3.3 Average packet end-to end delay

The delay time require between source and destination travelling. It varies time to time as network is light loaded or heavy loaded. Best network has less end-to-end delay time. There are several factors by which its rate changes e.g. network sharing, routing algorithm selection etc.

## 4. SIMULATION RESULT

In our wireless simulation we uses simulation framework for video transmission over the wireless network in Fedora environment [1]. Our simulation total 8 mobile nodes are taken out of them 4 source nodes and 4 destination nodes. All source node is a CBR source over UDP application. Each transmitted packet size is 512 bytes and transmission rate of each node is 600 Kbps. We also assumed that the all nodes are in transmission range at a distance of 195 meter apart. The simulation time taken for 80 sec [4].

We simulated it for three protocols (DSDV, AODV and DSR) and compared the simulation result for video transmission.

The instance variables are used for calculating the throughput, end-to-end delay and packet drop rate. The instance variables initialization shown in algorithm1. The bit rate, packet loss and end-to-end packet drop shown in algorithm 2.

**Algorithm1:** Initializing the variables

Step1: Set ns ← Instance of network simulator
Step2: Set sampling interval time ← 0.9 sec.
Step3: Set Instance variables for Bit Rate for all sink
    Set br[1..4] ← {sink[1..4] ← Set arrived bytes}
Step4: Set Instance variables for Packet Loss for all sink
    Set pl[1..4] ← {sink[1..4] ← Set not arrived packets}
Step5: Set Instance variables for End-to-End Packet Delay for all sink
    Set pd[1,3,5,7] ← {sink[1..4] ← Set last packet received time}
    Set pd[2,4,6,8] ← {sink[1..4] ← Set number of packet arrived}
Setp6: Set current value of network simulator instance
    Set current ← {ns now}

**Algorithm2:** Store Bit Rate, Packet Loss and End-to-End Packet Delay in Trace Files

```
Store brFile[1..4]←{current [((br[1..4]+holdrate1)
                 *8)/(2*time*1000000)]}
Store plFile[1..4]←{current [pl[1..4]/time]}

## Save End-to-End Packet Delay in File
if  pd[2,4,6,8] > holdseq[1..4]  then
   Store pdFile[1..4]←{current [(pd[1,3,5,7]–holdtime[1..4])
                  /(pd[2,4,6,8]–holdseq[1..4])]}
else
   Store pdFile[1..4]←{current [(pd[2,4,6,8]-holdseq[1..4])]}
end if
```

So we simulated it for three most popular performance evaluation metrics: throughput, packet drop rate and average packet end-to end delay. The metrics are simulated for three most popular wireless routing protocols: Ad Hoc On-demand Distance-Vector Protocol (AODV), Destination Sequenced Distance-Vector (DSDV) and Destination Source Routing (DSR).

## 4.1 Simulation result for AODV protocol

**Average packet End to End Delay:** Simulation result for performance evaluation metrics "average packet end to end delay" for AODV wireless routing protocol shown in figure 2.

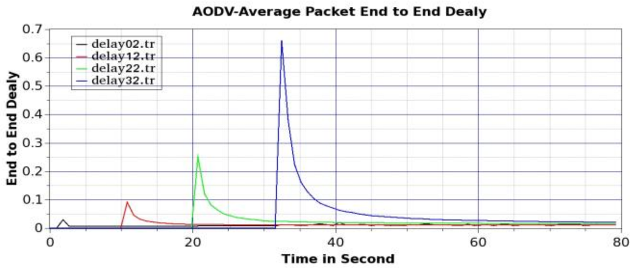


**Fig.** 2: Average packet End to End Delay for AODV protocol

Figure 2 shows as we increase nodes delay will be increased. After all 4 nodes started the maximum delay is 0.66 sec.

**Packet Drop Rate:** Simulation result for performance evaluation metrics "packet drop rate" for AODV wireless routing protocol shown in figure 3.

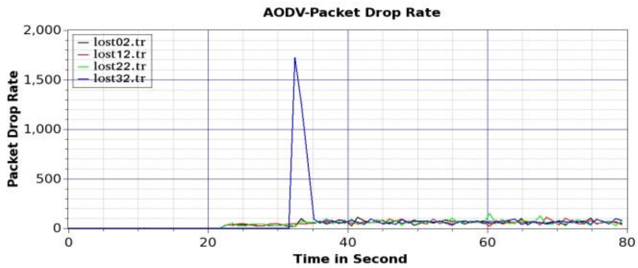


**Fig.** 3: Packet Drop Rate for AODV protocol

Figure 3 shows packet drop rate increases as we increase the nodes. The maximum packet drop rate is 1726.67.

**Throughput:** Simulation result for performance evaluation metrics "throughput" for AODV wireless routing protocol shown in figure 4.

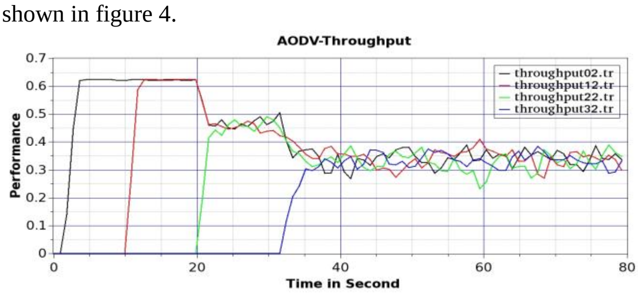


**Fig.** 4: Throughput for AODV protocol

Figure 4 shows throughput decreases as we increase the nodes. The maximum throughput is 0.62.

## 4.2 Simulation result for DSDV protocol

**Average packet End to End Delay:** Simulation result for performance evaluation metrics "average packet end to end delay" for DSDV wireless routing protocol shown in figure 5.

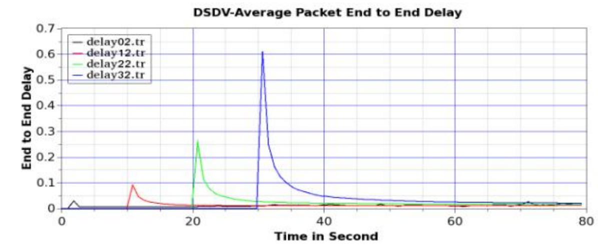


**Fig.** 5: Average packet End to End Delay for DSDV protocol

Figure 5 shows as we increase nodes delay will be increased. After all 4 nodes started the maximum delay is 0.61 sec. This result is better than AODV.

**Packet Drop Rate:** Simulation result for performance evaluation metrics "packet drop rate" for DSDV wireless routing protocol shown in figure 6.

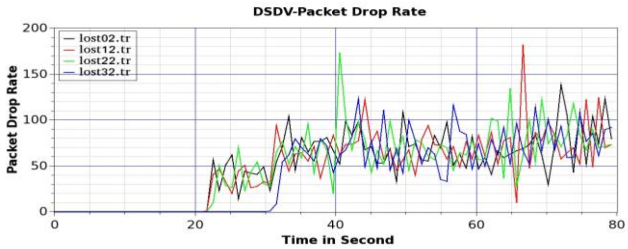


**Fig.** 6: Packet Drop Rate for DSDV protocol

Figure 6 shows packet drop rate increases as we increase the nodes. The maximum packet drop rate is 182.22. This result is better than AODV.

**Throughput:** Simulation result for performance evaluation metrics "throughput" for DSDV wireless routing protocol shown in figure 7.

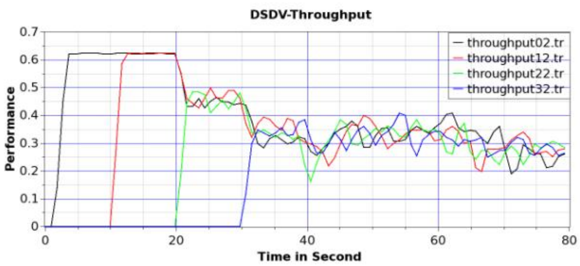


**Fig.** 7: Throughput for DSDV protocol

Figure 7 shows throughput decreases as we increase the nodes. The maximum throughput is 0.62. This result is same as AODV.

## 4.3 Simulation result for DSR protocol

**Average packet End to End Delay:** Simulation result for performance evaluation metrics "average packet end to end delay" for DSR wireless routing protocol shown in figure 8.

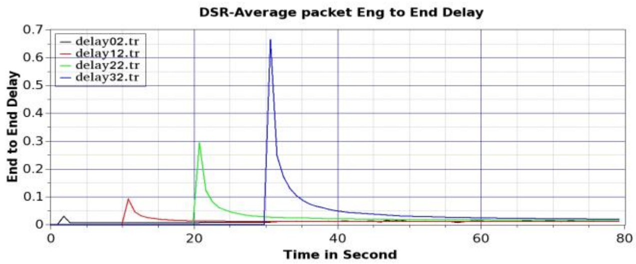


**Fig.** 8: Average packet End to End Delay for DSR protocol

Figure 8 shows as we increase nodes delay will be increased. After all 4 nodes started the maximum delay is 0.67 sec. This result is higher than AODV and DSDV.

**Packet Drop Rate:** Simulation result for performance evaluation metrics "packet drop rate" for DSR wireless routing protocol shown in figure 9.

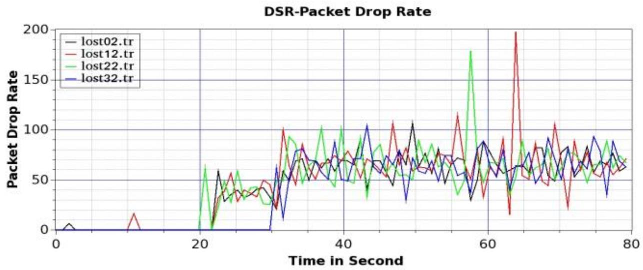


**Fig.** 9: Packet Drop Rate for DSR protocol

Figure 9 shows packet drop rate increases as we increase the nodes. The maximum packet drop rate is 197.7. This result is higher than AODV and DSDV.

**Throughput:** Simulation result for performance evaluation metrics "throughput" for DSR wireless routing protocol shown in figure 10.


**Fig.** 10: Throughput for DSR protocol

Figure 10 shows throughput decreases as we increase the nodes. The maximum throughput is 0.60. This result is less than AODV and DSDV.

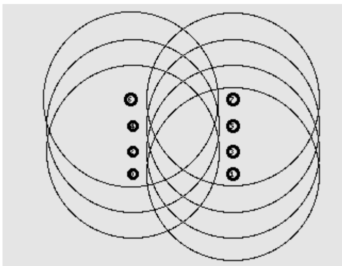

**Fig.** 11: Initial Stage of topology at 0.0 sec

## 4.4 NAM output for DSDV protocol

Network Animator (NAM) output also show same result as discussed in point 4.1 to 4.3. The initial stat of topology at 0.0 sec shown in figure 11.

**Fig.** 12: First Node Transmission Started at 1.4 sec

Figure 12 shows transmission has started on first node and there is not packet drop at this time 1.4 sec.

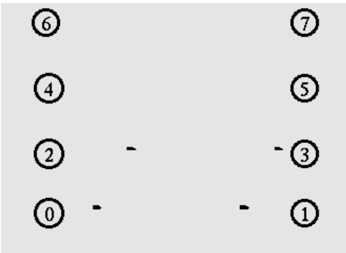

**Fig.** 13: Second Node Transmission Started at 10.1 sec

Figure 13 shows transmission at second node also started after 10 second with first node and still there is no packet drop at this time 10.1 sec. So we are increasing the traffic.

Figure 14 shows transmission at third node also started after again 10 second with first & second nodes and still there is no packet drop at this time 20.0 sec. So we are continuously increasing the traffic.

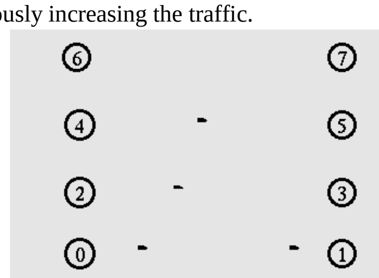

**Fig.** 14: Third Node Transmission Started at 20.0 sec

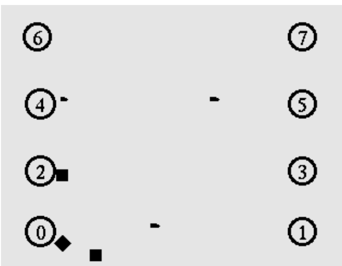

**Fig.** 15: Packet drop started after Third Node at 21.0 sec

Figure 15 shows there is packet drop has started after third node starting at 21.0 sec.

Similarly in figure 16 the fourth node also started transmission means all four nodes have started at this time 30.0 sec. The packet drop rate has been increased. So as we increases the traffic the packet drop increases and throughput decreases as well as end-to end packet delay also increases.

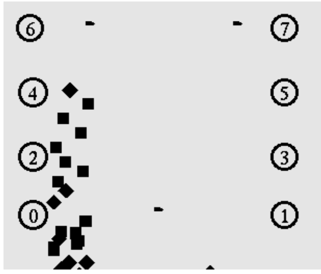

**Fig.** 16: All Nodes started and packet dropping rate continue at 30.0 sec

## 5. RESULTS

Our simulation shows that if number of nodes increase in wireless network its performance decreases. Fewer packets lost/dropped in AODV. Better throughputs in DSDV.

**Table 1:** Comparison of Throughput

| Proto-Col | Throughput | | | | |
|---|---|---|---|---|---|
| | Node 1 Starts Transm-itting at | Node 2 starts Transm-itting at | Range After all Node Started | Mini-Mum | Maxi-Mum |
| AODV | 1.8 sec | 10.8 sec | 0.12-0.39 | 0.12 | 0.62 |
| DSDV | 1.4 sec | 10.8 sec | 0.12-0.41 | 0.12 | 0.62 |
| DSR | 1.8 sec | 10.8 sec | 0.01-0.37 | 0.10 | 0.60 |

Node 1 starts transmitting at time T =1.4 sec (in DSDV) while Node 2 starts transmitting at time T=10.8 sec. During the period of time [1.8 sec, 10.8 sec] Node 1 is the only transmitting node using the entire available bandwidth. This justifies the high performance of Node 1 during the specified interval of time. At time T=10.8 sec, Node 2 starts transmission hence sharing channel resources with Node 1. The throughput decreases as the number of transmitting nodes increases.

The comparison of throughput for all three routing protocols is shown in table 1. This figure shows that maximum throughput is 0.62 and when all 4 nodes started DSDV gives better throughput. Similarly DSR give minimum throughput i.e. 0.60.

**Table 2**: Comparison of Packet drop rate

| Proto-Col | Packet drop rate | | | | |
|---|---|---|---|---|---|
| | Node 1 starts Transm-itting at | Node 2 starts Transm-itting at | Range After all Node Started (sec) | Mini Mum | Maxi Mum |
| AODV | 22.5 sec | 10.8 sec | 34.44-1726.67 | 3 | 1727 |
| DSDV | 22.5 sec | 21.6 sec | 1.11-123.33 | 1 | 182 |
| DSR | 1.8 sec | 10.8 sec | 12.22-104.44 | 7 | 197 |

The graph in section 4 shows a high packet drop rate when more number of nodes starts sharing resources of network. It can be shown that the packet drop rate in the interval [1.8 sec, 10.8 sec] is 0. We can easily justify this because only one node is using the network during this time interval. However this high-quality performance is depreciated as more nodes start sharing the network resources.

The comparison of packet drop rate for all three routing protocols is shown in table 2. This figure shows that minimum packet drop rate in DSDV protocol i.e 182. Similarly maximum packet drop rate has in AODV protocol i.e 1727. The table 2 again shows DSDV is better protocol for mobile wireless network.

When the number of nodes increases for sharing the network resources, the End-to-End delay considerably increases. The comparison of average packet end-to-end delay for all three routing protocols is shown in table 3. This figure shows that minimum packet delay in the maximum range is 0.61 for DSDV protocol. Similarly DSR have maximum packet delay i.e 0.67. The table 3 again shows DSDV is better protocol for mobile wireless network.

**Table 3:** Comparison of Average packet End-to-End Delay

| Proto-Col | Average packet End-to-End Delay | | | | |
|---|---|---|---|---|---|
| | Node 1 Starts Transm-itting at | Node 2 starts Transm-itting at | Range After all Node Started (sec) | Mini-Mum (sec) | Maxi-Mum (sec) |
| AODV | 1.8 sec | 10.8 sec | 0.02-0.66 | 0.01 | 0.66 |
| DSDV | 1.8 sec | 10.8 sec | 0.02-0.66 | 0.01 | 0.61 |
| DSR | 1.8 sec | 10.8 sec | 0.02-0.67 | 0.01 | 0.67 |

# 6. CONCLUSION

Using simulation framework for video transmission over the wireless network in Fedora environment [1] simulations were done for throughput, packet drop rate and average packet end-to end delay of wireless network UPD-based application for various routing protocol and the results gives that DSDV protocol is better for UPD-based application for wireless network

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