Improved Video Transmission over MANETs using MDSR with MDC

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Abstract— MANET does not have any fixed infrastructure, so the mobile nodes are free to move within a network which results in dynamic change of network topology. The Real-time video transport has rigid bandwidth, delay, and a loss requirement to support this application in Mobile Ad-Hoc Networks is a challenge. MANET consists of mobile nodes that cause frequent link failures. This link failure causes two main problems. First, when a route break occurs, all packets that have already transmitted on that route are dropped which degrades the video quality and it decreases the average packet delivery ratio (PDR). Second, the transmission of data traffic is halted for the time till a new route is discovered and it increasing the average end-to-end delay. For that we have proposed Node-Disjoint Multipath Routing Based on DSR Protocol with Multiple Description Coding Technique (MDC). Node-Disjoint Path means there is no common node between two paths and MDC encode a media source into two or more sub-bit streams. The sub-streams, also called descriptions. The experiment has been done using NS2 simulator with Evalvid for evaluating the video quality. Our proposed scheme will improve Packet Delivery Ratio, Throughput and Decreased Average End-to-End Delay.

Keywords: Mobile Ad hoc Network (MANET), Multiple Description Coding (MDC) Packet Delivery Ratio, Throughput, Average End-to-End Delay.

I. INTRODUCTION

MANET is self- configuring network of mobile node connected through wireless link. In other words, a MANET is a collection of communication nodes that wish to communicate with each other, but has no fixed infrastructure and no predetermined topology of wireless links. Every node in a MANET is free to move separately in any track, and will thus change its links to other devices repeatedly. Node is free to move separately into the network. In the recent year , there is growing interest in video communication over wireless network due to its a lot applications in the areas of military and other disaster relief applications with the advances of wireless communication and video coding technologies. To, providing reliable video communications over wireless ad-hoc networks has so many challenges. The challenges begin from the dynamic change in the network topology of the network and the weakness of compressed video to packet losses. While the transmission range of the mobile node is limited, multiple hops are required for a node to transmit its information to other node involved in the network for the purpose of energy saving. So, in MANET, routing protocols are needed to set up communication paths between nodes. Due to the mobility, the path between source and destination is break at any time and thus communication becomes a tedious problem. At the same time, since the connection is dynamic for all nodes in MANET, so for that it is needed to design more than one path between source and destination. This is done using Routing protocol in MANET, It is term as Multipath Routing which is store one then one routes in it routing table. There are two types of multipath node disjoint path and link disjoint path, node disjoint path means there is no common node between two path and in link disjoint path there is no common link between two path.

So, multipath transmission can distribute traffic between a set of different disassociate paths which is offers load balance and route failure protection. Thus, from the various error resilient techniques, Multiple Description Coding with multipath is useful for transmitting video over wireless lossy network [1, 2, and 3]. MDC generates multiple descriptions which are independent with each other so each description can be reconstructed the source with acceptable quality, video packet loss because of node mobility and changing dynamic network topology. MDC with Multipath is robust technique to losses since all the description are not loss simultaneously if one description is loss still we get expectable video quality [4].

In this work, a scheme is design to improved Packet Delivery Ratio, Throughput and Decreased Average End-to-End Delay by using Node disjoint multipath using Dynamic Source routing Protocol with Multiple Description Coding Techniques.

The work is implemented using NS2 and Evalvid for simulation and the proposed method of video transmission over ad hoc network using MDSR with MDC to improve Packet Delivery Ratio, Throughput and Decreased Average End-to-End Delay.

The paper is structured as follows. Section II describes the related work. Section III describes the architecture of the proposed work Section IV described Results and Section V conclusion of the paper.

II. RELATED WORK

In Node-disjoint path (NDMP-AODV)for video transmission in MANET is also useful in the lossy wireless network[5].node disjoint multipath(NDMP-AODV)are designed to transmit video on MANET, first find node disjoint path whenever gets first path towards the destination it transmit video on that path and all other are stored as backup route in the routing table[5]. Layer coding [3] concept is used for video transmission, which encodes the video into two layers namely, base layer and an enhancement layer. The base layer (BL), which includes the crucial part of the video frames, guarantees a basic display

quality. Each enhancement layer (EL) correctly received improves the video quality. But without the BL, video frames cannot be reconstructed sufficiently. Due to this property, it is not possible to partially recover lost information of one substream, using information carried in other correctly received substreams. But MDC method overcomes this problem by generating multiple equally important streams, each giving a low but acceptable quality. A good-quality reconstruction is decodable from all bit streams received together, while a worse, but still tolerable quality reconstruction is possible only if one stream is received. The correlation among the substreams introduced at the encoder makes it possible to partially recover lost information of one substream, using information carried in other correctly received substreams. However, such a correlation limits the achievable coding efficiency, as compared with a conventional coder designed to maximize it. A key challenge with this codec is how to control the mismatch between the reference frames used in the encoder and those used in the decoder caused by transmission errors. Supporting video transmission over error-prone mobile ad-hoc networks is becoming Increasingly[6] important as these networks become more widely deployed for that this propose a routing aware multiple description video coding approach to support video transmission over mobile ad-hoc networks with multiple path transport and build a statistical model to estimate the packet loss probability of each packet transmitted over the network based on the standard ad-hoc routing messages and network parameters then estimate the probability of frame loss and select. Multiple description coding (MDC)[7] to the compressed domain, by proposing efficient splitting of standard single description coded (SDC) video into a multi-stream representation. A novel multiple description video splitting (MDVS) scheme is proposed to operate at network edges, for increased robustness in path diversity video streaming across heterogeneous communications chains. It is shown that poor performance of existing methods is mainly due to distortion accumulation, i.e., drift, when decoding is carried out with missing descriptions. In[8]MDC with optimal picture classification into two priorities. A binary classification algorithm is proposed to define high (HP) and low (LP) priority network abstraction layer units (NALU), which in turn define the packet priorities. An optimization algorithm is used to find HP pictures, based on dynamic programming and relying on minimization of the packet loss concealment distortion. The paper shows that the proposed algorithm is able to effectively improve the decoded video without increasing the MDC stream Redundancy. The overall performance evaluation, carried out by simulating MDC video streaming over lossy networks with path diversity, demonstrates that the proposed algorithm yields higher video quality for a wide range of packet loss rates (PLR).

III. PROPOSED WORK NODE-DISJOINT MULTIPATH DSR ROUTING PROTOCOL (MDSR) WITH MULTIPLE DESCRIPTION CODING TECHNIQUE (MDC)

1) Design Node-Disjoint Multipath using DSR Routing Protocol.
2) Encoding Video Using Multiple Descriptions Coding Technique**.**

In this section, the proposed MDSR protocol is described. The main goal of MDSR is to find all available node disjoint routes between a source-destination pair and store all the route in routing cache in FIFO form and after that transmit video using MDC on that path. To achieve this goal MDSR protocol works in three phases: (i) Route Discovery Phase, (ii) Route Selection Phase and (iii) Route Maintenance Phase.

A. Design Node-Disjoint Multipath using DSR Routing Protocol.

1) Route Discovery Phase

In Route Discovery phase there are two Message 1) Route Request Message and 2) Route Reply Message are use for determined route from source to destination. The source node floods the RREQ message into network. Each intermediate node that received RREQ ,check whether it is duplicate or new one searching in its Seen Table. Seen Table stores two entries (i.e. Sequence No and RREQ ID (*REQ_id*)) that uniquely identify a RREQ message in the network. If an entry is present in the Seen Table for the received RREQ message, it is considered a duplicate RREQ message and discarded without further broadcasting. Otherwise, the node creates an entry in the Seen Table and updates its routing cache for forward path before broadcasting the RREQ message.

Sequence No	Request ID	Route Record	Seen Flag

Table (1): MDSR Seen Table Structure

In MDSR, only Destination node can send Route Reply Message (RREPs) Receiving upon RREQ Message from source node. The intermediate nodes are forbidden to send RREP message even if they have an active route to destination. This is done to get the node-disjoint route. In MDSR the destination node has to send a RREP message for each RREQ received, even if the RREQ is a duplicate one. In Seen Table I add extra field that work as flag known as seen flag and another Route Record Filed. This flag is set to FALSE initially. When entry is inserted in Seen Table after receiving first RREQ message and node which receives RREQ that entry is stored in Route Record. The RREP Message initiated by Destination node in MDSR contains two extra field which is Broadcast ID (b_id) and Route Record.

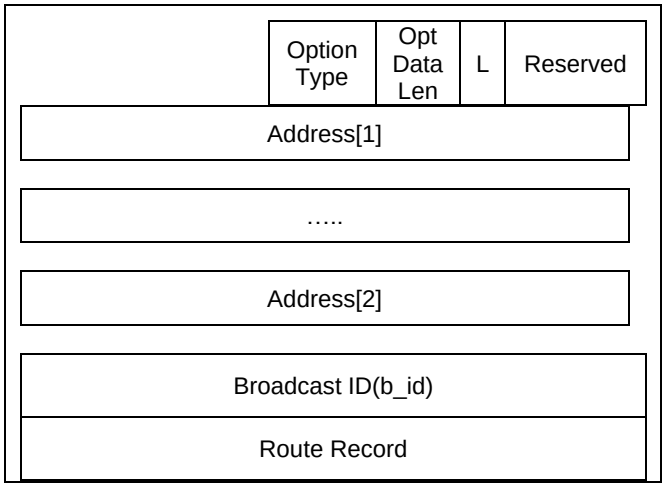

Table (2): MDSR Route Reply Message Structure

The route Discovery method use to discover Node-disjoint Path. When destination node receives a RREQ message, It creates the corresponding RREP message. The destination node copies the REQ_id from the received RREQ message into the b_id field of sent RREP message and route record from which RREQ had Traversed. This RREP message is unicast towards the originator of RREQ using reverse path to construct the forward path. For every received RREQ (i.e. either first or duplicate), the destination node do the above mention process.

When the intermediate nodes in the reverse path receive the RREP message, they check the seen flag value in their Seen Table and also check Route record in seen table. If the seen flag is set to FLASE, this indicates that this is the first RREP message on the reverse path towards the source node. So, the intermediate nodes send the RREP towards the source and reset the value of seen flag. When the intermediate node get RREP message for same RREQ message it check route record in seen table if Route record is same as got earlier Route then node simply discards RREP base on Route record in seen flag. When the route record is different Than RREP message for the same RREQ message they reset value in their seen table .now value of seen flag is FALSE and intermediate nodes send the RREP towards the source and reset the value of seen flag. Due to this, the intermediate nodes can take part on any two route from the existing multiple routes.

MDSR Route discovery process when a node receives RREQ message.
N = Node
S = Source Node
D = Destination Node
I = Intermediate Node
$S\ Addr$ = Source IP Address
D $Addr$ = Destination IP Address
REQ $\_id$ = REQ id field of RREQ
$B\ \_id$ = broadcast id field of RREP
R=Route Record
S _flag= FALSE// Initial value of seen flag seen table
n_routes
X = FALSE
Count=0
if S has data to send then
if S has route for D then
Startdata _transmission ()
end if
else
insert RREQ _seen table()
insert _seen table()//insert entry in seen table to check for duplicates
initiate _RREQ flooding()
end if
if N receives a RREQ message then
if N≡ S ∨ N ≡ I then
X=check _seen table()// check for duplicate RREQs
if X then
discard _RREQ())// drop RREQ without rebroadcasting
else
relay_RREQ ()//rebroadcast RREQ
else
N is the destination
B id=REQ id
R=Link list of source to destination path
Initiate _RREP()// destination node send unicast RREP on forward route to create reverse route given in Route record
end if
end if
MDSR route discovery process when node receives RREP message
if N receives RREP then
if N≠S then
X=check_seen flag()//check and return the value of seen flag from seen table
if ¬X & R then
insert_first_route() // Insert first route in routing cache
change_seen flag() // reset the value of seen flag in seen table
Relay_RREP() // forward RREP towards Source
else
if X then
check_R()// if route record is different from earlier send RREP
change_seen flag() // reset the value of seen flag in table
insert_secondary_route() // Insert secondary route in routing cache
change_seen flag()
else
if R then
insert_Backup_route () //is multiple routes are stored at intermediate nodes
discard_RREP() // drop the duplicate RREP to ensure the finding of node-disjoint route
end if
else

X=check_seen flag()
if N≠S then
insert_first_route()
change_seen flag()
else if
change_seen flag()
insert_secondary_route()
else
change_seen flag()
Count=count_route() // count the number of active backup route for destination in routing cache
If Count<n_route then
insert_backup_route()// insert Backup route in routing cach
else
discard_RREP ()
end if
end if
end if
end if
end if

The DSRM algorithm is principally design to find node-disjoint Multipath routes, store that route in routing cache and transmit video on that Multipath. I will use the following notation

S = Source Node
D = Destination Node
Here, I use one network topology to demonstrate algorithm

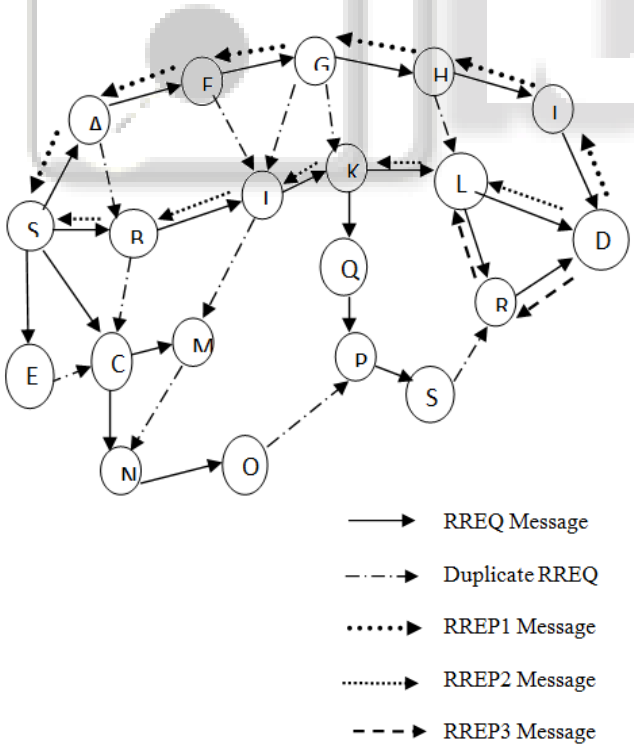

Fig. 1: MDSR route Discovery Process

Above Figure 1 show that how route discovery process in MDSR and how to get all node-disjoint paths between source and destination. Suppose node S is source node and node D is Destination node, When Source node S has data to send Destination node D. Then Node S start route Discovery process by flooding route request (RREQ) in the network. Now guess that node D received first route request from intermediate node I at time t0 and Destination node D is initiate route reply (RREP1). RREP1 is unicast towards the Source node S through reverse path D→I→H→G→F→A→S. When RREP1 is received through an intermediate node along the reverse path each intermediate node reset the seen flag in their Seen Table and check the route record. Now assume that Destination node received duplicate route request from intermediate node L at time t1.

Then again Destination node initiate RREP2 and send it toward the source node S to reverse path it came to D→L→K→J→B→S and reset seen flag value and check route record. finally at time t2 Destination node D received another duplicate RREQ message from intermediate node R. Destination node D initiate RREP3 and send it towards the source node S Through R. when route RREP3 reach to M. it check seenflag value and route record before forwarding to next hop. If route is there in route record and seenflag value is set to true. So node M considers RREP3 as duplicate RREP and discard message. This route discovery process is help to maintain the node-disjoint property of our algorithm.

Route selection Phase & Data Transmission

When source node get it first route it start send one description and when other description is send through secondary route. The other node-disjoint routes which are discover later after first and secondary route are stored in routing cache as backup route. The route selection process works in FIFO pattern so whenever first or secondary route are not active then it will select route from backup route stored in routing cache for transmission.

2) Route maintenance Phase

Route maintenance process is invoked when an active route is broken during transmission of data. I will try to implement and analyze the performance of two route maintenance method in case route is broken.

1) When Transmission route is break, then the different routes in the same route cache are used to salvage packets that are in the way towards the destination. This scheme is increases video packet delivery ratio without retransmission.
2) In second route maintenance method, the source node starts the route discovery process as soon as it finds out that there is only one active path remaining in routing cache. In this way, the source has routes for destination at all time. This greatly reduces the delay caused by the rerouting process which is triggered by a route break.

B. Encoding Video Using Multiple Descriptions Coding (MDC) Technique

1) A multiple description (MD) coder encodes a media stream into two decodable streams which is called Description and transmits these descriptions

independently over the network. This description is assigned to the two paths by a traffic allocator. Traffic allocator assign first and second path from routing cache in Link List order and transmit description on that path if path fail than route maintenance process.

2) The description reach at destination, all description are put into re-sequencing buffer to get the original order of description.
3) Finally, the video data is extracted from the re-sequencing buffer to be decoded and displayed.

IV. SIMULATION RESULTS AND DISCUSSION

A. Implementation and simulation of the proposed work

This work is simulated using NS2 and Evalvid and compare proposed scheme with DSR routing for different performance metric Packet Delivery Ratio, Throughput and Average End-to-End Delay. I create network topology using 25node and give mobility to that node for movement. I have design multiple path using DSR routing protocol and divided video into two sub-sequence frame and those frame are encoded into two descriptor using MPEG-4 encoder. First I have taken one YUV Video, which is Flower_cif.yuv and the resolution of that video is 352×288.This video file is converted to a file as video input which has considering Inter packet time (sec), Frame size (bytes), Packet type, Packet priority, Maximum Fragment Size (bytes) using the mpeg trace converter while NS2 does not support real time video. This video input file is further encoded by MDC coding and it has given as input to the Evalvid.

1) I have add myevalvid/myudp.o, myevalvid/myevalvid_sink.o and myevalvid/myevalvid.o in the OBJ_CC list in the Makefile of NS2
2) After that i have add some extra coding lines in packet.h, agent.h, agent.cc of the Makefile in order to support Inter packet time (sec), Frame size (bytes), Packet type, Packet priority, Maximum Fragment Size (bytes),sendtime of frame in NS2
3) Recompile the Makefile.in First we transmit video using DSR routing protocol and analyze the performance metrics Packet Delivery Ratio, Throughput and Average End-to-End Delay and compare this performance metrics results with our proposed scheme MDSR with MDC performance metrics results.

Parameters	Values
Simulator	NS2
Number of Nodes	10,15,20,25
Area Size	500*500
MAC	802.11
Traffic Source	CBR
Video	Flower_cif(352 ×288)
Video Codification	MPEG-4
Frame Size	22 to 27650 bytes
Simulation Time(s)	100,200,300
Pause Time(s)	0 To 100
Bandwidth	10mb
Data Rate	10mb
Routing Protocol	DSR,MDSR
Interface Queue	CMUPriQueue
Transmission Protocol	UDP

Table (3): Simulation Parameter

B. Results and Analysis

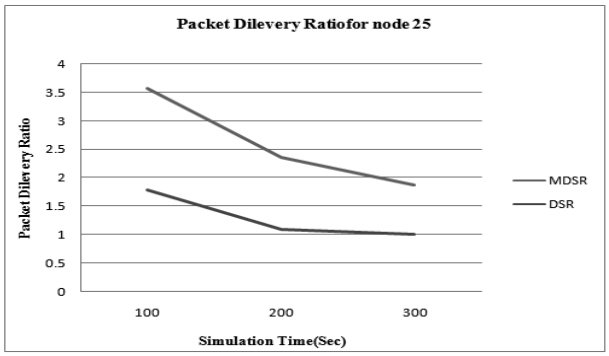

Fig. 2: Packet Delivery Ratio Vs Simulation Time Value

Figure 2 shows the results of simulation using DSR to transmit video, the packet delivery ratio is less but using MDSR packet delivery ratio is increases.

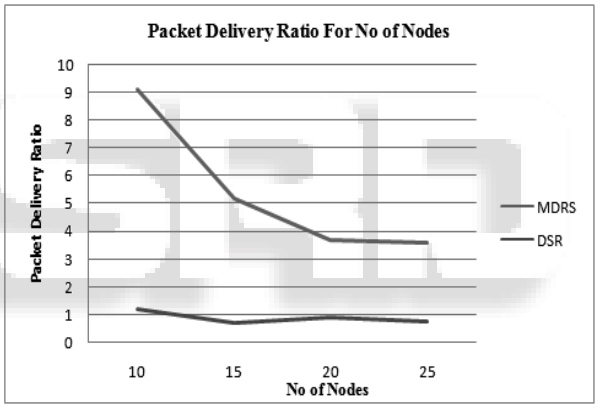

Fig. 3: Packet Delivery Ratio Vs. No of Node

Figure 3 shows Packet Delivery Ratio (%) is measured as average number of packets received at destinations during transmission time and its average is taking place for number of nodes. Packet Delivery Ratio is decreased when the number of nodes increased.

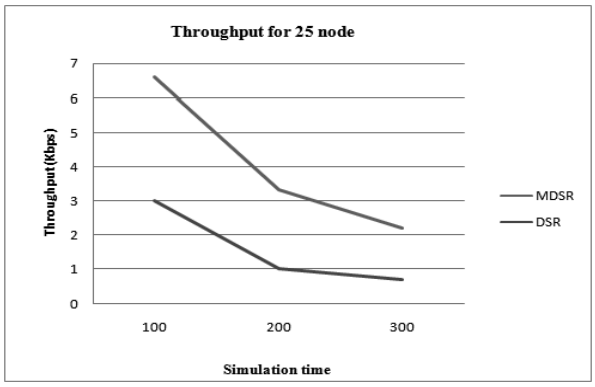

Fig. 4: Throughput Vs. Simulation Time Values

Figure 4 shows the results of simulation using DSR to transmit video, Throughput is less but using MDSR Throughput increase but as simulation time increases throughput is decreases.

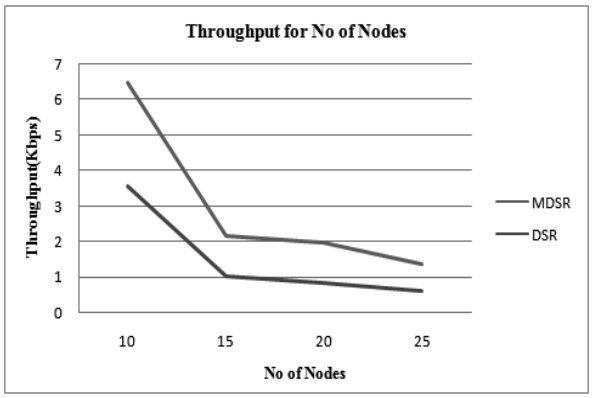

Fig. 5: Throughput Vs. No of Nodes

Figure 5 shows Throughput (Kbps) is measured as average number of data packets received at destinations during the time of sensing and Average of Throughput is taking place base on number of nodes. Throughput is decreased when No of Nodes increased.

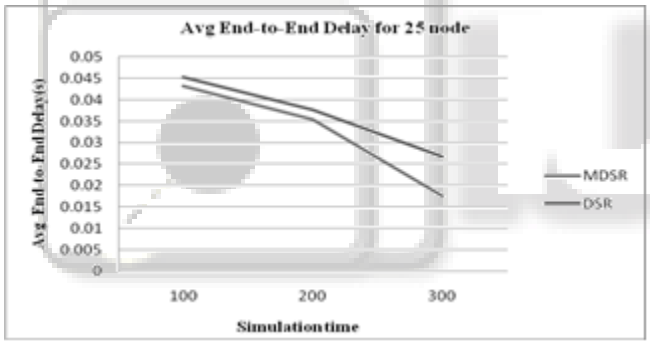

Fig. 6: Average End-to-End Delay vs. Simulation Time Values

Figure 6 shows the results of simulation using DSR delay is high but using MDSR delay is decreases as simulation time increases.

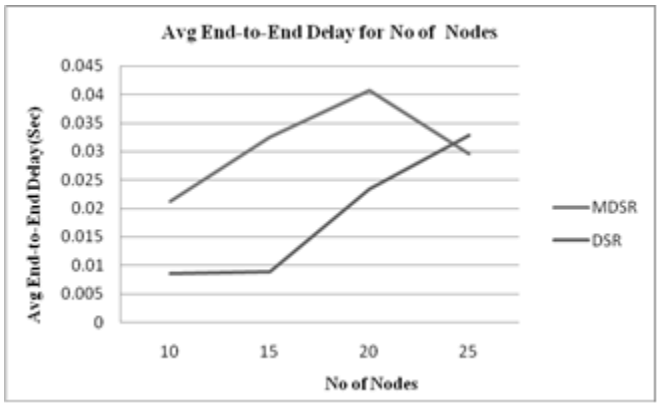

Fig. 7: Avg. End-to-End Delay vs. No of Nodes

Figure 7 shows End-to-end delay (sec) is measured as average time afar a packet originate on the source node and packet receives at the destination node and its average is taking place based on number of nodes. End-to-End delay decreased at node 10 but it will increase at node 25.

Above results are obtained from implementing both DSR and MDSR in various performance metrics with different simulation time and different pause time. The results are based on statistic multipath which is positive and encouraging. So the video transmission using routing and Evalvid which shows that the video quality can be considerable with propose scheme.

V. CONCLUSION AND FUTURE WORK

The Real-time video transport has rigid bandwidth, delay, and a loss requirement to support this application in Mobile Ad-Hoc Networks. Because MANET consists of mobile nodes that cause frequent link failures. This link failure causes two main problems Packet Loss and Delay Because of Retransmission of Packet for the reason that Video quality is degrade. To improve video quality the node-disjoint multipath with DSR Routing protocol and multiple description coding technique is proposed. Node-Disjoint Multipath we transmit one description on one path and second description on second path. Which improve Packet Delivery Ratio, Throughput and Average End-to-End delay. Existing work can be extended to including High mobility and Route Selection process in multipath and implement this work in realistic scenario.

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