



DESIGN AND PERFORMANCE INVESTIGATION OF MULTICAST PIM-DM AND PIM-SM PROTOCOLS OVER IPV6

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ABSTRACT

Business and multimedia entertainment applications need sending at the same time to multiple users or specific groups. IP multicast is an efficient and scalable network layer delivering mechanism for multimedia content to a large number of receivers over the Internet. It has mechanism that offers bandwidth optimization and reductions the time required for sending data to multiple destinations. In traditional IP networks, packets are sent to single target (unicast). Currently, the demand of multimedia communication has increase in several fields; especially multimedia applications such as video and audio, distance learning and entertainment. Furthermore, Application requirements forwarding packets in the same time to multiple users or specific groups. Unicast protocol has a number of problems preventing its successful deployment of these applications. These problems contain inefficient bandwidth, high cost, congestion and more collision in the networks. Thus, Multicast protocols through IPv6 were developed to overcome these problems. There are already exist a few protocols implementing multicast transmission in real networks like PIM-SM and PIM-DM. In this paper, simulation was done using NS-2 simulator to evaluate the performance of each those protocols based on delay, jitter, packet loss and throughput with variable receivers. The paper consists of one main scenario; which involves of network topology with a few numbers of receivers with three sources, seven receivers and seventeen intermediate nodes. Simulation shows that, the PIM-SM has the better result in term of packet loss, delay, jitter and throughput. Therefore, this results show that, the PIM-SM protocols are more appropriate to be utilize in WAN environments.

Keywords: PIM-SM, PIM-DM, IPV6, NS-2.

1. INTRODUCTION

An Internet Protocol (IP) is a group of instructions which termination of ideas in network usage to connection. Protocols happen at some layers in the connection structure such as OSI reference system [1]. In this system, every layer determines a protocol for connect with its peer layer on the other side of the network. The protocol must have a technology that creates certain which receive of messages is in the similar instruction as it was transferred and must pledge which the packages are not wasted, repetition or destroy in crossing over connection. Furthermore, the protocol must realize the method to information interchange, flow control, discovery of error and rectification, etc. Usual IP connection is among one transmitter and one recipient. Nevertheless, to several applications, it is indispensable to a procedure for forward information to a lot of number of recipients together. Moreover, some instances are information updating, dispersed information bases etc. Internet protocol (IP) bolsters multicasting, in that exertion are completed for convey the information to every of the members of the set classified. A collecting is number of recipients, who have like address named multicast address. No assurances are assumed which every one of the individuals from the gathering will get information. Original IP multicast routing model, suggested through means of Steve Deering concentrated on numerous to-numerous connection services. This connection structure named Any Source Multicast (ASM) [2] has number of specified and advertising issues [3]. For example, address distribution, inactive management of multicast sources and defensive

multicast sets from unauthorized transmitters that limit its extensive scale distribution. There is additional structure that underpins one to several and numerous for numerous connections. This one-to-several and numerous to numerous connections service structure is named Source Specific Multicast (SSM) [4] and has been reflected as a possible structure to organize multicast service in the Internet. This service structure depends on application linking the channels that are recognized via the tuple (S, G), where S is unicast source address and G is multicast set address. Internet Protocol version 4 (IPv4) was presented in 1981 [5] structures the spine in the present Inter-network with gigantic number of PCs everywhere throughout the world. The quantity of PCs is expanding quickly step via step and has brought about the exhaustion of IPV4 address.

Besides, behest to novel internet protocol version happening in 1995 [6], to give further elastic, effective and secure version of IP named Internet Protocol Plus and later chosen as IPv6.

Recent the request of multimedia information has improved several folds in the last few years. Typical multimedia applications are mostly distance knowledge, conference tools audio and video, multiplayer gaming etc. These applications request effective allocation of information to a huge set of recipients that are discrete through enormous geographical distances. With the expansion, popular of these applications, the requisite to convey such media over multicast rather than unicast has likewise incremented. Network applications where mass allocation is necessary cannot utilize unicast due to the



high cost involved. Multicast protocols over IPV6 is the greatest key for servicing multimedia applications. Several applications for example video conferencing, real time multimedia applications and allocated cooperating simulations have emerged that are intended to originate maximum advantage from multicasting of information. These applications are cared on use sure inherited characters of a multicast protocol to transport the coveted QoS. The performance investigation of multicast protocols there are different programs available to aid the user in simulating for network applications. Also, in this paper the implementation of a given scenario has covered the performance of the analysis multicast routing protocols PIM-SM and PIM-DM through IPV6 likewise answered the question of which is the best routing protocol the performance metrics based on different QoS that is utilize the simulator NS-2.

2. INTRA-DOMAIN MULTICAST ROUTING PROTOCOLS

The multicast methods are categorized based on intra-domain or inter-domain. The multicast routing protocols based on intra-domain have become very advanced between the several intra-domain routing protocols. In this paper, it has been used two multicast routing protocols that were mentioned as follows:

2.1 PIM-dense mode (PIM-DM)

In a PIM-DM routing protocol is allowed with PIM-DM occasionally forward messages to realize neighbouring for this protocol and specific foliate networks and foliate routers. Furthermore, this routing protocol is accountable to selecting a specific router on a multi-access network.

This routing protocol is advanced beneath the presumption which when a multicast source forwards information, each network nodes in the field requisite to collect the information. Packages are sent in the overflow and prune technique. When the source forwards information, each interfaces on the router send the information, unless the RPF interface which match to the source. Consequently, each network nodes in this protocol field collect the multicast packages.

To send the multicast packages, intermediate routers requisite for make entrances of multicast to multicast set and source of multicast. Entrances of multicast cover address of multicast source, address of group, arriving interface, timer, and flag. If no member of multicast set occurs in a confident region, routers in the region forward. Messages of prune to tentatively prune far or hang the interface which forwards multicast packages to the region. When the interface arrives the trimmed case, a timeout timer begins. When the timer deceases, the case of the interface alterations from pruned to sending again. Furthermore, the message of prune consists data around the source of multicast and set. If a novel multicast set organ is discovered in the pruned region, the system of downstream does not postpone to the case of trim to

expire. The voluntarily of system directs a Graft message to the upstream system for alteration the case of trimmed to the sending case and reduction reply time.

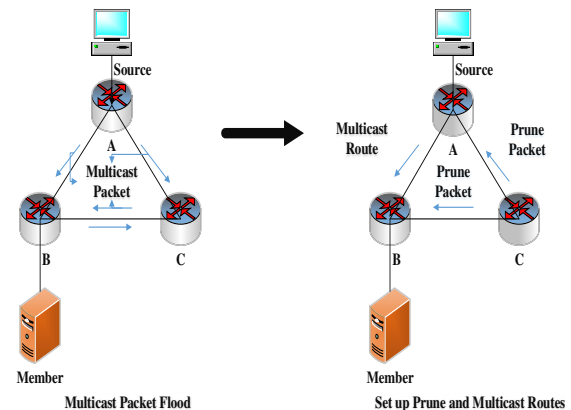


Figure-1. Flood and prune process in PIM-DM.

In the beginning, the information forwarded over the source of multicast is overflowed through the network. Protocols make the RPF realize when sending packages. Consequently, the flooded packages forwarded via routers B and C for together be disallowed because of the RPF realize unsuccessful. The reason behands this issue that the region where router C establish has no member of multicast set, router C directs a message of prune to routers A and B. Consequently, routers A and B group consistent interfaces to the case of trimmed, and the multicast packages are forwarded for each set members over the right tracks.

2.2 PIM-sparse mode (PIM-SM)

This routing protocol purposes for implement effective routing to multicast sets which may extend a huge region and inter field Internet. The technique is declared to as PIM-SM routing protocol as it is not depending on any special unicast routing protocol, and in order to that it is aimed to instrument scattered sets.

This routing protocol is based on a Multicast Routing Information Base (MRIB) for bring the next hop to a distention subnet [7] it is occupied with each the current paths in the model via routing protocols such as MBGP. The information is forwarded in the opposite route of Join message. Rendezvous point (RP) is the origin node of the allocation tree for a multi-access set. This item is got automatically by a boot bangle method, or over still shape [8]. The stage one of the protocol formulates an allocation tree to multi-access. The recipients supply the agreement to getting multi-access traffic over wherewithal of IGMP or MLD messages. The recipient assign one local router to its limited subnet. Each the DR is forwarded JOIN messages across the RP to multi-access transfers. This message is recognized as a (*, G) Join since it accede set G for each sources to which set.

The Multicast transmitter forwarded the multi-access information for the set by the DR. The DR Unicast



something the information and directs them for RP. The encapsulated packages are named PIM register packages. RP encapsulated the in information and sends them to the meant common tree. The packages then keep track up the multi-access tree case in the routers on RP. Then, it is repeated anywhere in the RP Tree sections, and finally getting each the recipients to which multicast set [7]. The second stage of PIM-SM procedure is the record STOP method.

In addition, the trip back and forth among a RP and participate of tree may take a huge time. Finally, the messages arrive the subnet S and the packages stream access the RP. Moreover, RP is in the procedure of source linking in particular packages, information packages keep going to encapsulate to RP. The third stage of PIM-SM routing protocol is the creation of Shortest Path Tree (SPT). The stage outcome in improve of the sending tracks. This is completed to accomplish low delay and an effective bandwidth section. The path via RP may not constantly be significant. It may issue important delays through crossing of tracks. DR may start a transmission from tree of participated to source definite SPT over use a source and group for join message. Information packages then stream from source to the recipient nodes attaching the source and group entry.

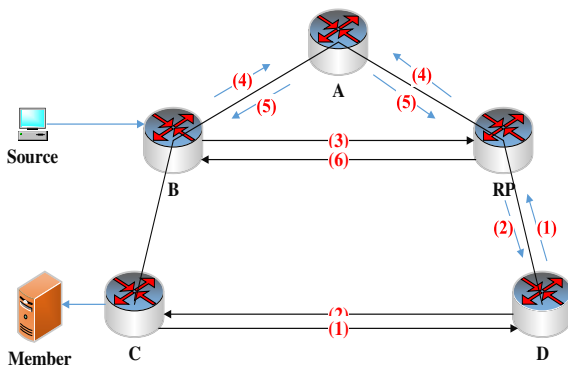


Figure-2. Example of working process of PIM-SM.

3. RELATED WORK

This section presents an overview of the use of multicast routing protocols in wireless networks. It offers summarizes and comparatively analysis the routing approaches of several current multicast routing protocols based on the features of mobile Ad-Hoc network [9]. Furthermore, it has been attentions on performance of tree and mesh based multicast routing protocols by MANET. Likewise, it evaluates well recognized multicast routing protocols such as on-demand multicast routing protocol (ODMRP), PIM-DM and multicast open shortest path first (MOSPF) under a wide range of network situations and genuine scenarios [10]. In addition, it performance investigation method can be utilized via network protocol creators for structure and exploiting best protocols when set up networks so as to accomplish the better performance under the multicast traffic load and quality characteristics [11].

On the other hand, it gives an insight into the merits and demerits of the currently known research techniques and provides a better environment to make reliable MRP. It presents an ample study of various QoS techniques and existing enhance ment in mesh based MRPs. Mesh topology based MRPs are classified based on their enhancement in routing technology and QoS modification on On-Demand Multicast Routing Protocol (ODMRP) protocol to improve performance metrics [12]. Moreover, it estimates the performance of PIM-DM and PIM-SM routing protocols depend on packet loss variable receivers via IPV6. The study contains of one main scenario, which contains of network topology with a few numbers of receivers with three sources, seven receivers and seventeen intermediate nodes. The results show that, PIM-SM has better results in terms of packet loss [13].

In [14], the simulation was done by QualNet simulator to design and performance analysis of OLSR and DYMO based on WiMAX network. The results show the DYMO routing protocol batter than OLSR routing protocol in terms of different QoS such as delay, packet delivery ratio, jitter and throughput.

The authors in [15] compares of theses routing protocols OLSR and DYMO over WiMAX based on End-To-End delay by QualNet simulator. The results prove that the DYMO better than OLSR routing protocols in terms of delay.

4. MATERIALS AND METHODS

4.1 Simulation tools

In this paper, simulation is done using NS-2 simulator. To evaluate and analysis the performance of the two protocols, PIM-SM and PIM-DM multicasting routing protocols for WAN environment over IPV6. The performance will calculate utilizing variable receivers. Furthermore, the simulation is carried out through node densities 33.

4.2 Simulation scenario

The general aim of this simulation study is to analyze the performance of various multicast routing protocols in Mobile WAN environment over IPV6. In addition, the scenario presented in two cases. In the first case the multicast network was configured and four multicast groups were created, with one source and the few numbers of receivers for each group, with arbitrary topology that we can represented in NS-2. Table-1 represents the multicast distribution used in our simulation.

**Table-1.** Multicast group description used in the simulation.

Multicast groups	Sources	Receivers
Group 0	30	13,20,23,26
Group 1	24	28,30,33
Group 2	21	23,25,27
Group 3	18	22,24,26

The network is consisting of 33 nodes: 3 source (S1, S2, S3, S4), 9 receivers (R1, R2, R3, R4, R5, R6, R7, R8, R9) and 21 intermediate nodes (N0, N1, N2, N3, N4, N5, N6, N7, N8, N9, N10, N12, N13, N14, N15, N16, N17, N18, N19, N20).

The rendezvous point (RP) is needed only in networks operating PIM-SM. In this protocol, only network sections with active recipients which have openly demanded multicast information will be sent the traffic. This technique of receiving multicast information is in disparity to the PIM-DM structure. In PIM-DM, traffic of multicast is firstly overflowed to each sections of the network. Routers which have no downstream neighbours or straight linked recipients prune back the undesirable traffic. An RP works as the meeting position to sources and recipients of multicast information.

In a PIM-SM network, sources must forward their traffic to the RP. This traffic is then sent to recipients down a common allocation tree. So, when the first hop router of the recipient learns around the source, it will forward a connection message openly to the source, making a source-based allocation tree from the source to the recipient. This source tree does not contain the RP except the RP is placed within the shortest route among the source and recipient. In general, the situation of the RP in the network is a complex choice. So, the RP is required only to start novel sittings with sources and recipient.

In this paper, used the RTP (Real-time Transport Protocol) to provide end-to-end delivery services for data with real-time characteristics. RTP defines a standardized packet format for delivering audio and video over the internet. It is designed for end-to-end, real-time, transfer of multimedia information. The protocol gives facility for jitter compensation and detection of out of sequence access in information which are shared through transmissions on an IP network. RTP supports information transmission to multiple targets through multicast. RTP is regarded as the primary standard for audio / video transport in IP networks. Real-time multimedia flowing applications need suitable delivery of data and able to tolerate some packet loss to realize this aim.

4.3 Simulation parameters

The simulation parameters used in this scenario to develop the network are listed in Table-2.

Table-2. Simulation parameters.

Multicast groups	Sources
Multicast Routing Protocols	PIM-SM, PIM-DM
Simulation Time	5s
Bandwidth	1.5 Mbps
Average Delay	10 ms
Packet Size	210 bytes
Number of Nodes	33
Traffic Type	CBR
Number of Source	4
Number of Intermediate Nodes	21
Number of Receivers	9
Simulation Name	NS-2

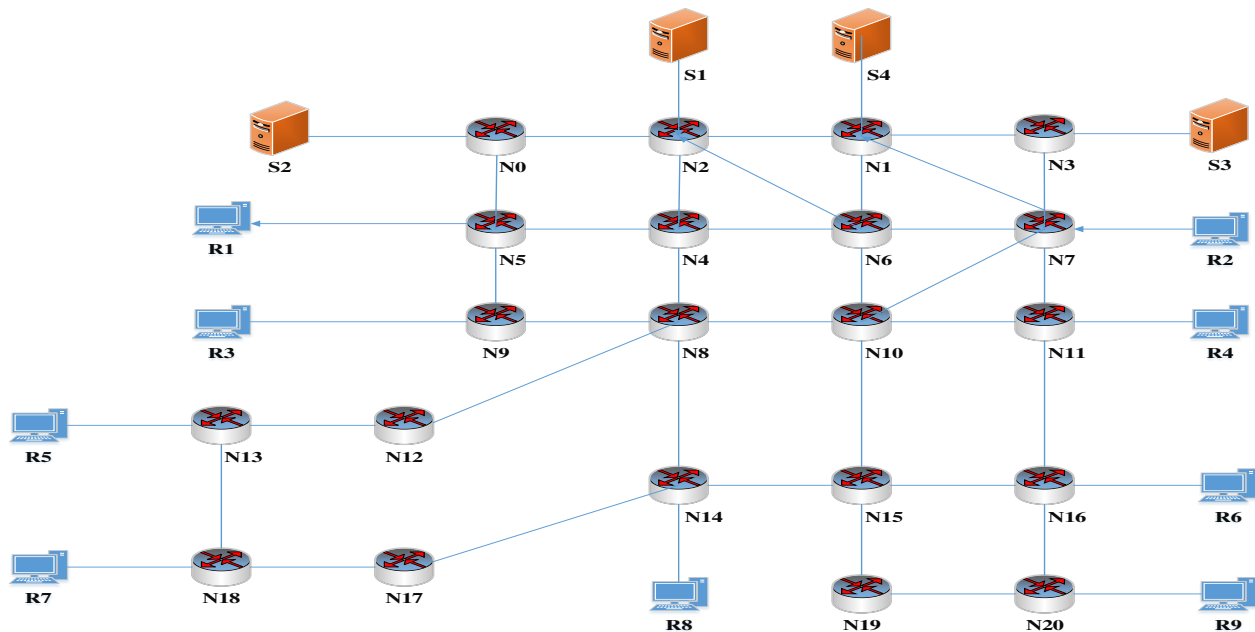


Figure-3. Network topology for the simulation.

4.4 Constant bit rate

Constant bit rate (CBR) is a term utilized in telecommunication and is an encoding technique that retains bit rate the same. It has a high speed due to its fixed bit rate value. The downside to a fixed bit rate is that the files process is not as optimized for QoS. In addition, it is suitable for flowing multimedia applications on limited ability networks. Furthermore, it is a simple queue management system utilized via internet routers to choose when to drop packages. In contrast to the more complex systems like RED and WRED, in Drop Tail all the traffic is not differentiated. Each packet is treated identically with Drop Tail, when the queue is filled to its maximum ability, the newly received packets are dropped until the queue has enough room to agree received traffic.

5. RESULTS

The results for these investigates were collected from output files generated via NS-2 simulator. It is the time taken for a packet to be communicated through a network from source to destination. The performance of PIM-SM and PIM-DM multicast routing protocols based on new design with different scenario to create our parameter aims. The quality of service is measured and analyzed of PIM-SM and PIM-DM multicast routing protocols.

5.1 Packet loss

In this scenario, the simulation had the aim to investigation the performances and behaviors in PIM-SM and PIM-DM environments. In this paper it mattered to perceive the flow multicast in every situation. The visual outcomes were assumed through the visual application NAM. It was created a networks with similar features, but the different here, PIM-SM will have had RP. We must to

know, where the RP should be located in the network when implementing a shared-tree design because it is so critical point. However, the paths among the source and receivers may not be the optimal paths in terms of hops. So the test for PIM-SM simulations with selection different RP points was done in case of packet lost. From Figure-4 the simulation will done via selecting the node 0, 2, 3, 6, 12 and 13 as RP.

To force the packet lost in the simulated network the bit rate was continually altered, from 100 Kbps to 1500 Kbps, with interval of 100 Kbps. The Figure-4 illustrates the behaviors of different RP's with packet lost in the simulation.

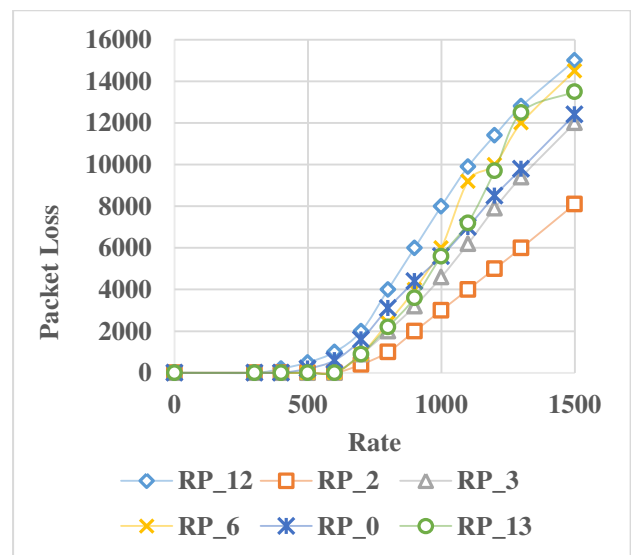


Figure-4. Packet lost in PIM-SM with differ RP's.



From Figure-4 it was noticed that the best RP's with the Packet lost in this networks is the RP in node 2, so the simulation will utilize this node in all latest scenarios. Furthermore, the RP must be taking, forcing to permit over it all the multicast flow, and only then redirecting the multicast traffic to the active recipients.

5.2 End-to-end delay

The simulation will calculate the average end-to-end delay per receiver by using the measure-delay. With constant bit rate 100 Kbps.

PIM-DM (SPT multicast) has the same end-to-end delay with unicast protocol. SPTs achieved through definition the best route topology among the source and the recipients in term of the number of hops, resulting in the minimum amount of network delay for allocating multicast traffic. Nevertheless, the multicast-capable routers are needed to keep route data for each source. In our network with both many sources and many groups, this state information overtax the router for memory resources required to store the multicast routing table.

PIM-SM (RPT multicast) require the minimum amount of state information in each router, thereby minimizing the memory requests for the routers and the technologies to maintain the state data up to information. Nevertheless, the paths among the source and receivers may not be the best routes in terms of hops and therefore, delay. PIM-DM has greater end-to-end delay average value than PIM-SM. Furthermore, the PIM-SM multicast routing protocol gets superiority percentage 36% in data rate 500 Kbps and 42% in data rate 1500 Kbps compared to PIM-DM multicast routing protocol.

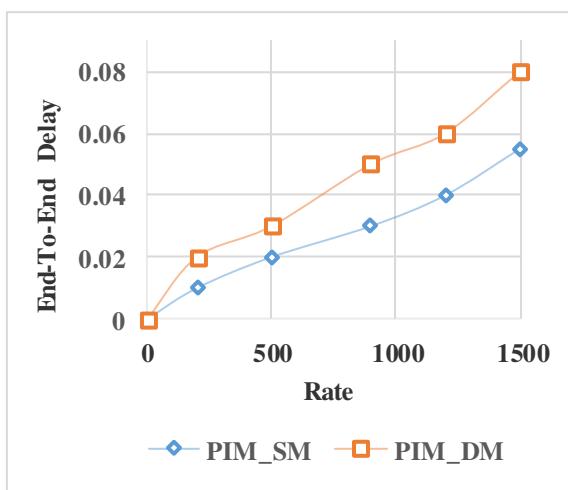


Figure-5. Average end-to-end delay.

By using the same program to get the end-to-end delay in the second simulation, the PIM-SM end-to-end delay still has the same value as we see in the simulation but the PIM-DM has the different value.

5.3 Jitter

In Figure-6 is shown the simulation results of rate vs jitter. Jitter plays a significant factor in audio/video streaming. PIM-SM routing protocol showed better stability in term of packet delay variation (jitter) between the source and the receivers in term of the number of hops due to definition the optimal path topology. In the data rate 500 Kbps we can see a superiority percentage among PIM-DM and PIM-SM is 37 %. On the other hand, in the data rate 1500 Kbps was superiority percentage is 28%.

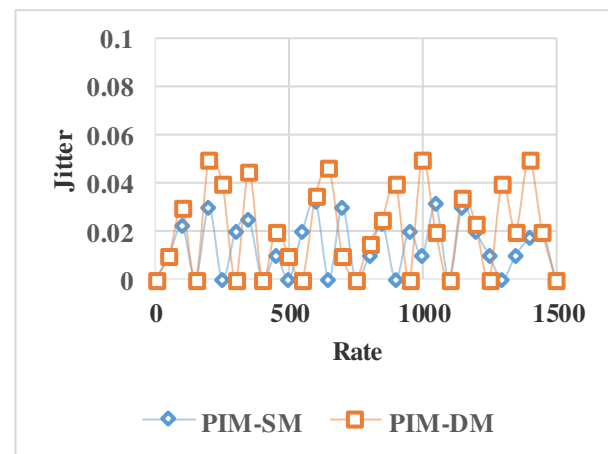


Figure-6. Jitter.

5.4 Throughput

Figure-7 shows the performance of both the routing protocols PIM-DM and PIM-SM for throughput. The PIM-SM has better throughput than PIM-DM in different experiment. In the data rate 400 Kbps PIM-SM routing protocol has a superiority percentage 45% compared to PIM-DM routing protocol. On the other hand, In the data rate 1500 Kbps was superiority percentage is 51% this because more routing packets are generated and delivered by PIM-SM multicast routing protocol with different rate.

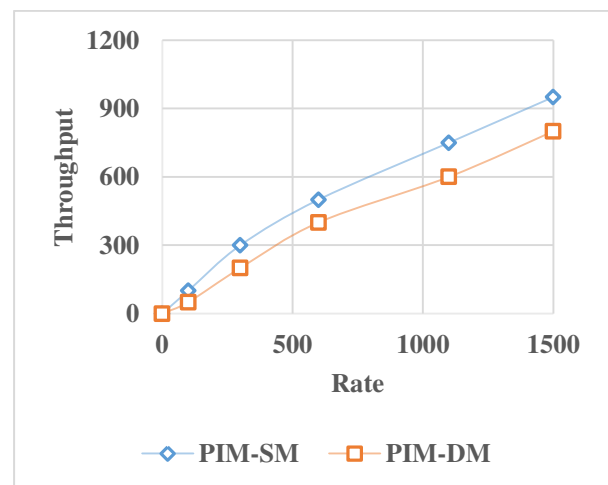


Figure-7. Throughput.



6. CONCLUSIONS

In this paper, the performance comparison and analysis of two multicast routing protocol PIM-SM (RPT multicast) over IPV6 in different number of packet sent in different experiments using NS-2 simulator. The simulator results show that the RPT multicast gets better QoS comparing to the SPT multicast in the specific data rate. The RTP is suited for the WAN networks and QoS will be better for multimedia applications.

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