Performance Of Infrastructure Less Based Multicast Routing Protocols In NS-2

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Abstract

Evaluations of Multicast Routing Protocols is being done on the basis of predefined metrics. To evaluate the performance of each protocol ns-2 simulator is used. The analysis is carried out using trace-graph version 202.MAODV and PUMA protocols are simulated and results are computed on the basis of performance metrics to find out best out of these protocols .

***Index Terms*— Multicast, Performance evaluation, network topology, node density, link capacity, end to end delay, re link usage, bandwidth consumption , jitter'**

Introduction

Multicasting is a communications service that allows an application to efficiently transmit copies of a data packet to a set of receivers that are members of a multicast group. The group is identified by a location-independent multicast group address. Senders use this address in the destination field of the packet; multicast routers forward the packet to group members using routing table entries for this address.

Steve Deering first suggested IP multicast in his PhD dissertation in 1988. The first usage of multicast on a wide scale was during an "audiocast" at the March 1992 IETF meeting in San Diego .This work deals with how multicasting is implemented in the Internet (IPv4) with emphasis on the implementation of multicast at the network layer . Multicasting has attracted a lot of attention in the fields like Military control operations to multicast tactical information , Sensor networks, Mobile commerce applications such as mobile auctions ,Rescue and disaster recovery , Intelligent transportation system and multimedia applications etc .Traditional multicast was achived in Infrastructure based environments but now days it can be possible in infra structure less networks

In adhoc Mobile Networks Methods for a Router to build up its routing table :

1) Tree based
2) Mesh based protocols

Tree based (One path between a source-receiver pair)

A tree based multicasting protocol maintains either shared based multicast tree or source based multicast tree to deliver information from senders to receivers of a multicast group. In a multicasting tree, there is usually only one single path between a sender and a receiver.

- Adhoc Multicast Routing (AMRoute)
- Multicast ad hoc on-demand Distance Vector Protocol (MAODV)
- AMRIS (Ad hoc Multicast Routing protocol).

Mesh based protocols : (Multiple paths between a source-receiver pair)

In a routing mesh protocol, there may be multiple paths between each sender receiver pair. Routing meshes are thus more suitable than routing trees for system with frequently changing topology due to availability of multiple paths between a sender and a receiver.

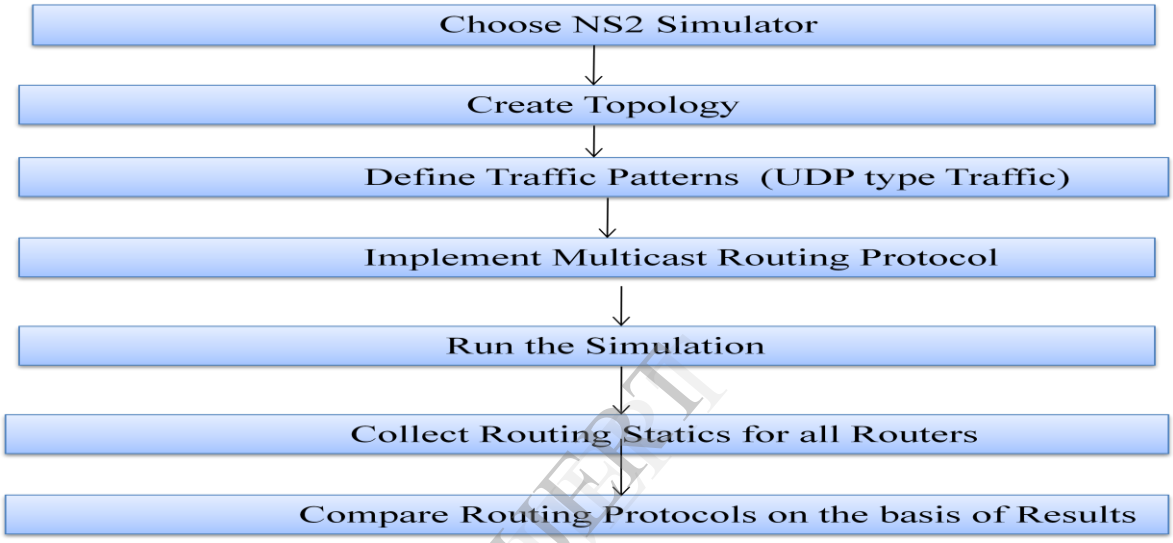
- Core assisted mesh protocol (CAMP),
- On demand multicast routing protocol (ODMRP)
- Protocol for unified multicasting through announcements (PUMA)

The implementation of following Infrastructure Less Multicast Routing Protocols in ns-2 is done.

1) Multicast Ad-hoc On Deemand Distance Vector (MAODV)
2) Protocol for Unified Multicast through Announcements (PUMA)

➢ Methodology Of Work

Following sequence of activities is adopted to carry out this work.



➢ Topology and Traffic Patterns

Simulations are performed Using 16 nodes (Nodes are connected in the form of mesh (of odrer 4x4))Traffic distribution to use for multicast is **Constant bit rate (CBR).**In this process, the packets are generated at the stations at a constant rate. This is one of the most simplistic models possible and exactly models CBR services. A CBR traffic generator creates a fixed size payload burst for every fixed interval.

Performance metrics

1 END TO END DELAY: Time elapsed between the generation of a packet at a source and the reception of that packet by a group member. Delay is the amount of time that it takes for a packet to be transmitted from one point in network to another point in a network. It refers to the time taken for a packet to be transmitted across a network from source to destination.

End to End Delay = Log x(dm/du) + Cost of Delay Unicast)

du = the delay experienced by a packet when sent in unicast mode.

dm = the average delay experienced by the packet in a multicast environment.

X = Base for Logarithm which is the ratio between da and du (acceptable delay) with the increase in delay the cost of multicast traffic should not be increased linearly. For example if the delay experienced by an application at one point is say 20ms and at another time its 40ms the cost should not be doubled but must be increased logarithmically. The value of 'x' will determine this increase in cost per increase in delay.

In ad-hoc networks End to End to End delay is as following.

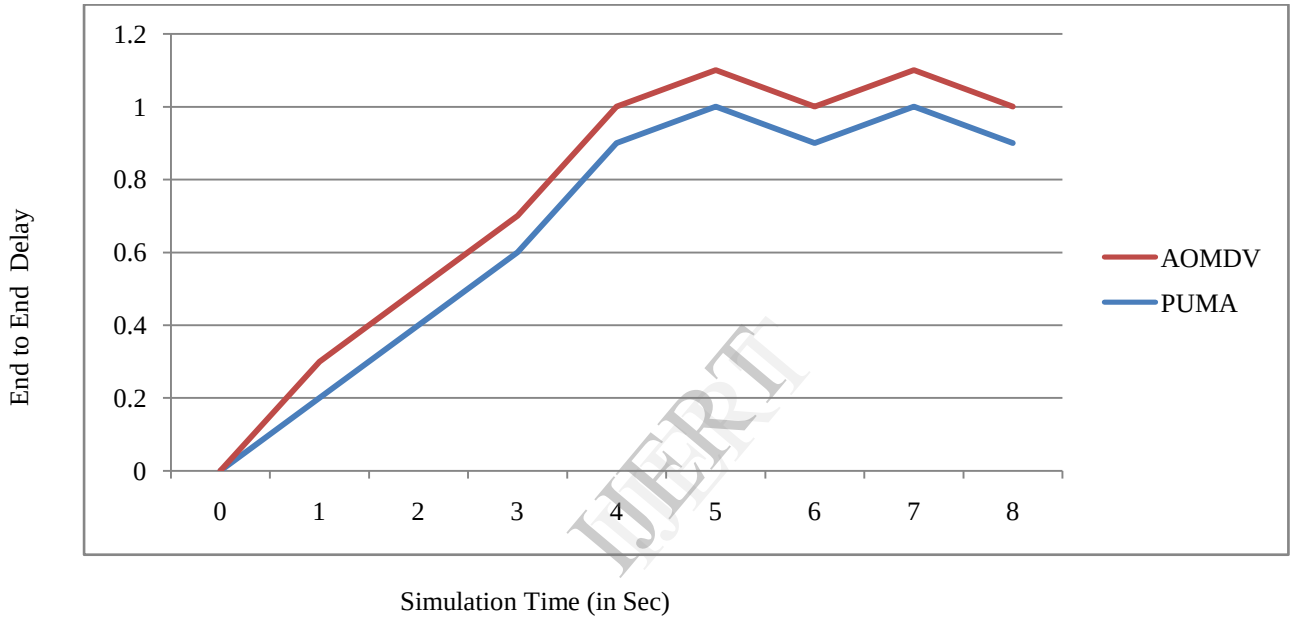


Fig 1: End To End Delay (Infra. Less)

Among AOMDV and PUMA ,AOMDV has higher End to End delay.PUMA has less End to End Delay. PUMA and MAODV are both receiver-oriented protocols. However, PUMA is a mesh-based protocol and provides multiple routes from senders to receivers. MAODV, on the other hand, is a tree based protocol and provides only a single route between senders and receivers.

Based on the results shown in Fig. 1, higher End-to-end delay values imply that routing protocol is not fully efficient and causes congestion in the network. As against the MAODV,

PUMA exhibits lesser values of End-to-end delay.

2. NETWORK RESOUSE USAGE

Network Resource usage is the number of hops traversed by a multicast packet when it is delivered from a sender to all the receivers. The cost of resources utilized within a core network by a multicast protocol is referred to as the 'Network Cost'. Network Cost is denoted by X(m) and is Mathematically defined as:

Network Cost= Nr(m)+ Sc (m)+ Ct (m)

Nr (m) = Link utilization.

Sc (m) = the storage overhead of the multicast transit nodes.

Ct (m) = the cost of overhead traffic (generated in the form of control messages).

In other words it is simply the number of nodes in a multicast tree lesser the number of nodes in a multicast tree, lesser numbers of links will be utilized. One of the main advantages of multicast over unicast is the lesser number of hops that are utilized in serving the entire multicast group.

In ad-hoc networks the communication takes place through hand-offs. The nodes which are participating in hand-off are taken as no. of hopes present in simulation with the care of being tree based or mesh based protocol functionality of both protocols respectively.

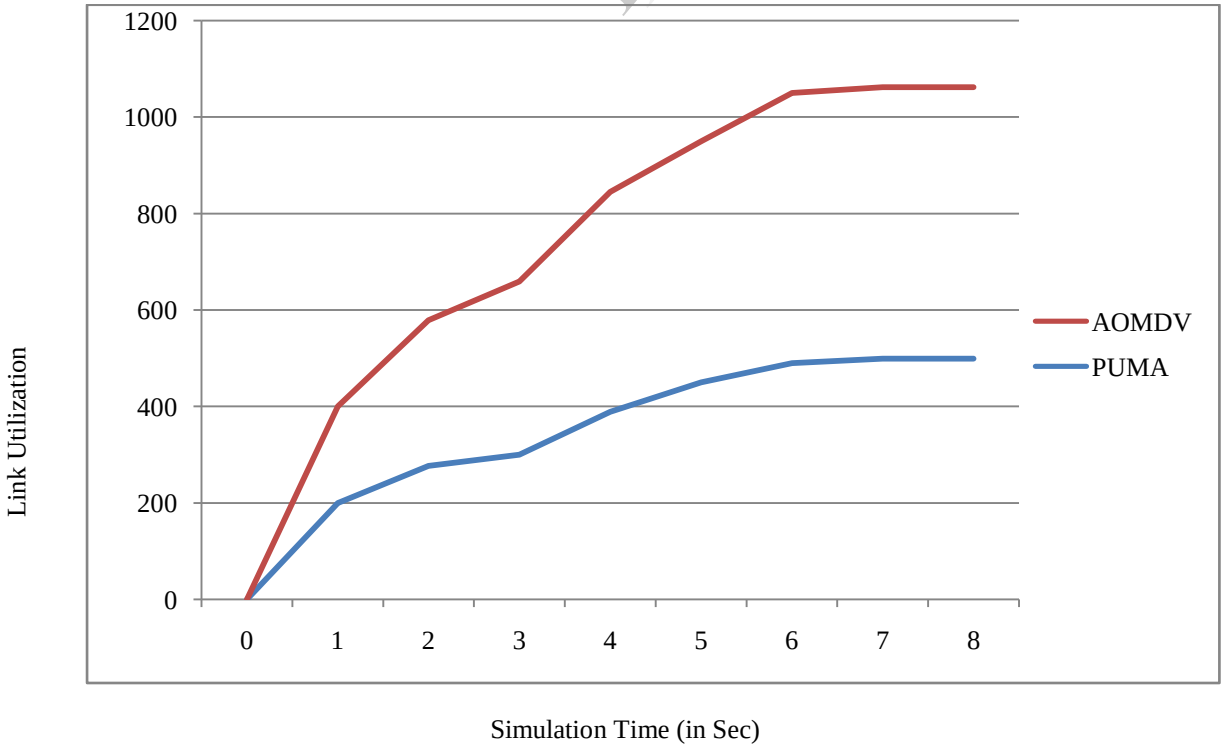


Fig 2: Network Resource Usage (Infra. Less)

PUMA performs better than the MAODV protocol, As it utilize the minimum resources of the network.

3. OVERHEAD TRFFIC PERCENTAGE

Multicast protocols generated considerable overhead traffic as compared to unicast protocols like UDP. A lot of control messaging is required to manage and maintain a multicast tree.

Overhead Traffic= Ct× St

St = Data Traffic × Unicast Hops

Ct = Cost of Overhead Traffic.

St = Traffic saved by avoiding duplication

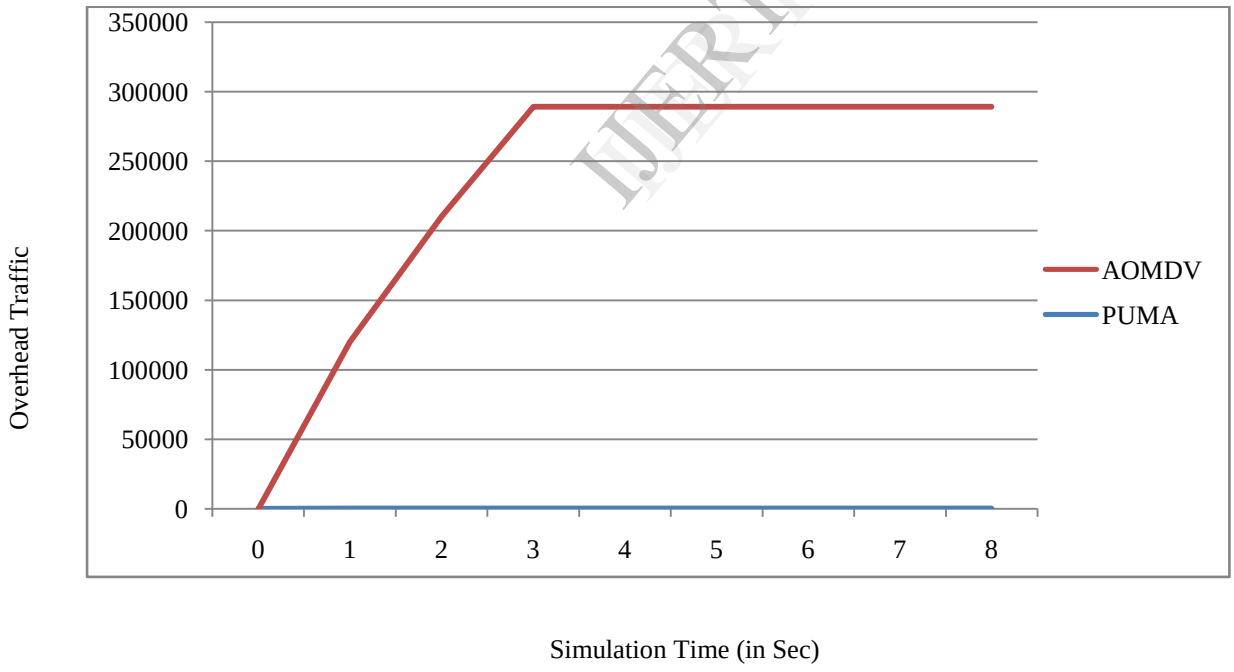


Fig 3: Overhead Traffic (Infra. Less)

Based on the simulation results shown in Fig 3 the routing overhead of PUMA is compared with MAODV for varying number of nodes. For increasing number of nodes, the routing overhead is increased in MAODV for varying number of nodes.

So, MAODV incurs far more overhead compared to PUMA.

4. THROUGHPUT

Throughput is a generic term used to describe the capacity of the system to transfer data. Throughput is nothing but the bandwidth of the transmission channel. Throughput is the rate at which network sends or receives data. Throughput is much harder to define and measure because there are numerous ways through which throughput can be calculated:

- The packet or byte rate across the network.
- The packet or byte rate of a specific application flow.
- The packet or byte rate of host to host aggregated flows, or
- The packet or byte rate of network to network aggregated flows.

We have calculated throughput using following formula:

Throughput = Packets received /unit time

In ad-hoc networks PUMA outperforms as compared to MAODV because it relies on very good technique of announcements. The chances of failure are less, because it can choose its leader dynamically without the interference of Network designer. So there is no single point failure like problems.

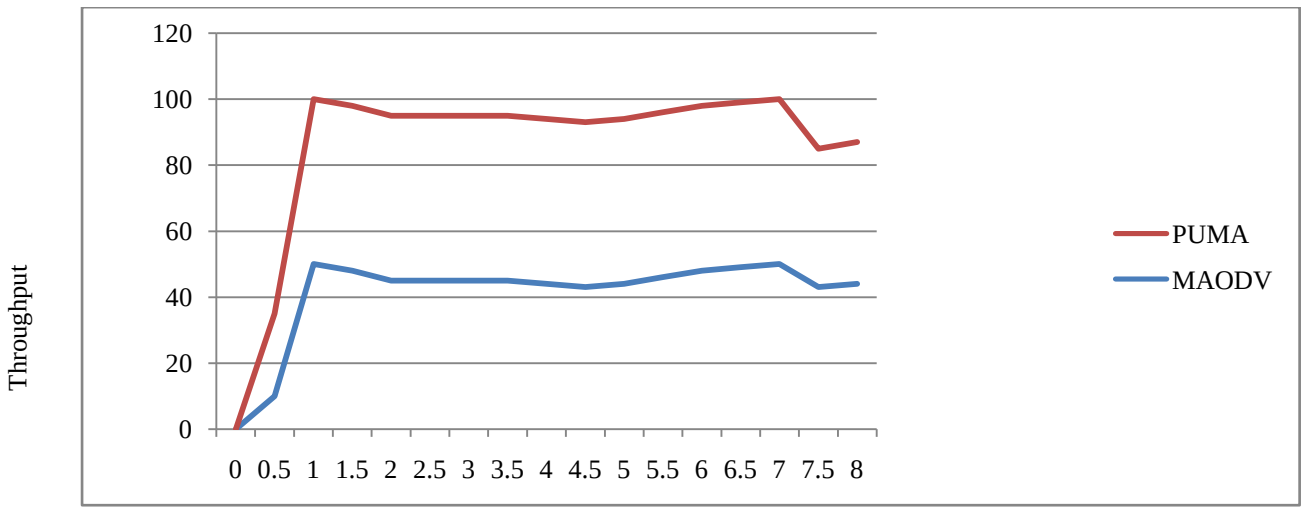


Fig 4: Throughput (Infra. Less)

Fig 4, shows the Throughput analysis. For increasing number of nodes the throughput of PUMA is higher than the MAODV.

5. JITTER

When a stream of packets traverses a network, each packet may experience different delay; this variation in delay is often called the jitter.

Jitter (multicast) = Log x $\sum(Xm - Mm) / \sum(Xu - Mu)$ + Cost of Jitter (u)

Xu = Average delay during unicast.

Xm = Average delay during multicast.

Mm = Delay experience by individual packets during multicast.

Mu = Delay experience by individual packets during unicast.

X = Base for Logarithm which is the ratio between Ja (acceptable jitter) and Ju With the increase in jitter the cost of multicast traffic should not be increased linearly. For example if the jitter experienced by an application at one point is say 20ms and at another time its 40ms the cost should not be doubled but must be increased logarithmically. The value of *'x'* will determine this increase in cost per increase in jitter

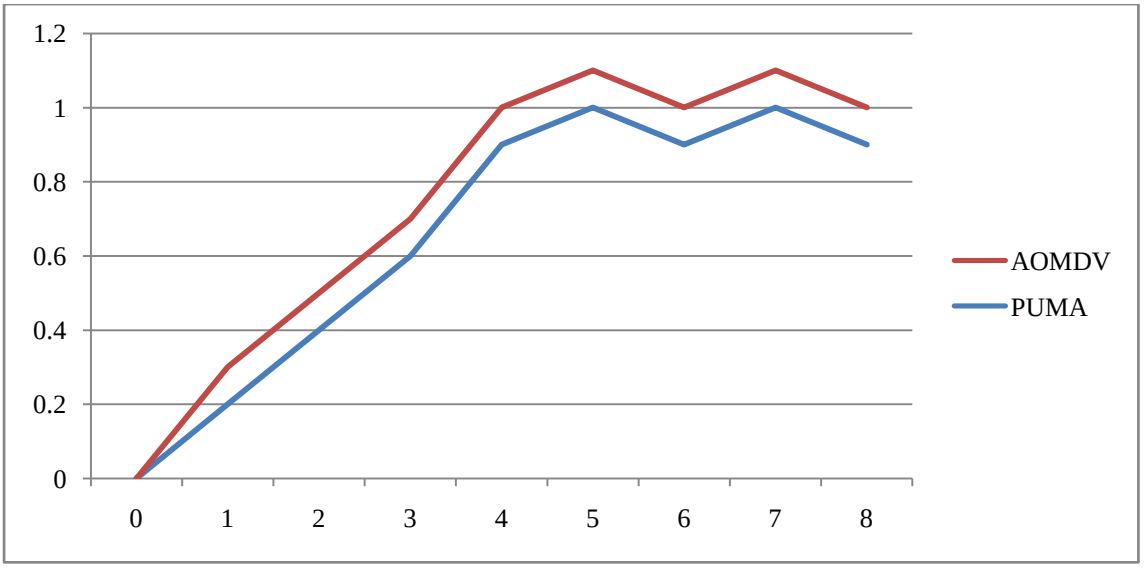


Fig 5: Jitter (Infra. Less)

Jitter in case of AOMDV is high as compared to PUMA according to Fig 16.

Table 15: Jitter (Infra. Less)

No. of Group Members	**Four**	**Eight**	**Sixteen**	**Thirty Two**
MAODV	0.6	0.8	1.1	1.2
PUMA	0.6	0.8	1	1

Based on the results shown in Fig. 16, higher End-to-end delay values imply that routing protocol is not fully efficient and causes congestion in the network. As against the MAODV,

PUMA exhibits lesser values of End-to-end delay

6 IMPLEMENTATION ISSUES

It is the cost of maintaining forwarding states for multicast group at intermediate routers. Each router, which is a part of a multicast tree, has to maintain forwarding states at its interfaces.

(1) Size of the routing table and

(2) the number of required timers.

These issues impact memory requirements, speed, and operating system performance. While in case of ad-hoc it is easy to realize a mesh based structure as compared to tree. So its tough realize tree as compared to mesh based structure

PACKET LOSS

Packet loss is where network traffic fails to reach its destination in a timely manner.

Packet Lost = amount of packets received - amount of packets forwarded

There are three causes of packet loss in the network

- A break in Physical link that prevents the transmission of a packetA packet that is corrupted by a noise and is detected by a checksum failure at downstream node and Network congestion that leads to buffer overflow. In case of ad-hoc only 10 percent as compared to infrastructure based are forwarded.

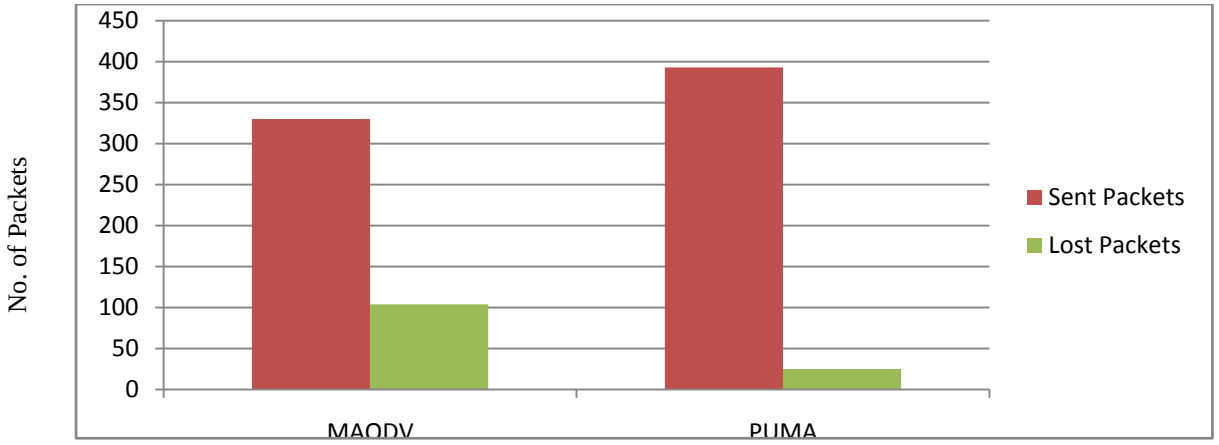


Fig 6: Packet Loss (Infra. Less)

The no of packets lose by PUMA is one fourth of the packets los by MAODV protocol.

- **CONCLUSIONS**

  In this paper we have evaluated the performance of multicast protocols according to performance metrics. PUMA outperforms as compared to MAODV .So it the best protocol from infrastructure less environment as the another protocols (AMRoute , AMRIS ,CAMP, ODMRP) are excluded from evaluation on the basis of literature survey.

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