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Comparative Performance analysis of MANET Routing Protocols for Real Time Multimedia Applications

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Abstract: ***MANET network is a collection of nodes which are wirelessly communicating with each other without need of any wired infrastructure. To deliver and exchange data across a network multiple network hops are required. Ad-hoc networks have been an object of interest not only because of the prospects they offer but also because of the numerous issues that faced by the system. One such issue is the distribution of high bandwidth real-time data via multicasting. This paper is on performance analysis of routing protocols like PUMA and OLSR on the basis of various performance metrics like Throughput, PDR, End to End delay and Energy consumption for multicasting multimedia data content on multi-hop Ad-Hoc network.***

Keywords: Multi-Hop, MANET, PUMA, OLSR, Real Time data, Multicasting

I. INTRODUCTION

Multimedia applications like video streaming are experiencing fast growth for diverse business needs. Applications of video streaming mainly include, examples are, commercial applications such as e-learning, video conferencing, stored-video streaming and military applications such as video surveillance of targeted field or specific objects. Video traffic is resource intensive and consumes a lot of network bandwidth, therefore it is challenging issue to stream video over limited-bandwidth networks, for example, WSN. In many cases, bandwidth usage implies direct cost on end-users [32]. In this paper, we try to focus on performance analysis of multicast routing protocols over MANET for real time video streaming.

Real-time multimedia data refers to applications in which data has to be delivered in real time; it can be broadly classified into interactive multimedia and streaming media-Multimedia is a term that describes multiple forms of information, including audio, video, graphics, animation, images, text, etc [32]. Some of its best examples which are continuous media such as animation, audio and video that are time-based, [32]. Multimedia data has to be presented in a continuous manner, in accordance with their associated timestamp. For example, for the illusion of smooth motion, video is typically rendered at 30 frames per second. As a result, real time constraint is typically considered in multimedia since media data has to be delivered and rendered in time [32] [29].

Techniques adopted by infrastructure networks like Wi-Fi or mobile cellular network are not even suitable for MANETs. Therefore Supporting real time video in MANET is complex task. Also due to inherent broadcast capability, MANET is well suited for multicast applications. To achieve our preliminary objectives, several routing protocols in the area of MANET should be examined.

a) MULTICAST SYSTEM:-

Now coming to multicast system, Multicast is a bandwidth-conserving technology that reduces traffic by simultaneously delivering a single stream of information to thousands of recipients. Multicasting is group oriented technique. This technique is

used in areas where one to many or many to one distribution is essential task. For supporting group communication applications, Multicast transmission is a more effective mechanism. Multicast is used in videoconferencing, corporate communications, e-learning, and distribution of software, stock quotes, and news in real time [11].

Due to the broadcast nature of the medium and the limited capabilities of the transceivers, the performance of multicast technique is questionable. Hence, Proposed system consist study of the performance of the multicast routing protocols for real-time content distribution in a multi hop Ad-hoc network.

II. LITERATURE REVIEW

There are many works focalized on performance analysis of multicast routing protocols over MANET. The most of those related works take in consideration only the best effort traffic. In proposed work, our basic contribution is the comparative performances analysis of MANET routing protocols for streaming multimedia applications like video.

Jogendra Kumar studied the performance of OLSR protocol in the paper named "Performance Analysis and Simulation of OLSR Routing Protocol in MANET [5]," in this paper author simulate and implement OLSR routing protocol and checked the performance at 200 nodes. This paper concludes that OLSR protocol gives better performance in dense network due to proactive routing nature [5].

According to S Sumathy and et al "Analysis of Multicast Routing Protocols: Puma and Odmrp [8]", proposed MANET is an autonomous system of wireless mobile hosts, that dynamically create a temporary network connected by wireless links and creates an infrastructure less network. The topology of the network may change. This paper presents the comparative analysis of two multicast routing protocols, AODV, PUMA and ODMRP. According to the performance results between AODV, PUMA and ODMR, for group communications, multicast routing increases the efficiency and they conclude that more suitable protocol for video is PUMA [8].

Swarna Parvathi.S and K.S.Easwarakumar proposed "multicasting of scalable video streams over WiMAX networks".[7] Multicast routing protocol PUMA is used to achieve scalability in the network. In this they encode the video using Scalable Video Coding and streamed through the multicast WiMAX network. And through simulations the have analyzed PSNR. They also concluded that SVC out performs better in WiMAX networks than WLAN [7].

III. PROJECT WORK

Project involves comparison of two different Ad-Hoc routing protocols. OLSR (Optimized link state routing protocol) and PUMA(Protocol for Unified Multicasting through Announcements). OLSR is proactive protocol which is table driven. Through periodic updates it keeps track of routes to all nodes in the network. This protocol was not originally designed to accommodate the multicast feature. The same could be implemented with the addition of certain features to the original protocol. PUMA is an Ad-Hoc multicast routing protocol in which all the features needed to achieve the multicasting of data over MANET are implemented.

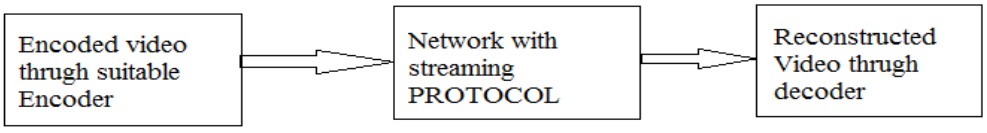

Fig. 1. Flow diagram

a) OLSR:

Optimized Link State Routing protocol[30] is a table driven routing protocol which periodically exchanges routing information between nodes and stores it on every node. Since it is scalable to multiple hops Protocol does not need to implement any changes in the format of IP Packet. Multi Point Relays (MPRs) are the most important concept in OLSR

functioning which are integral to the protocol. MPRs reduces protocol traffic and avoid multiple retransmissions of the data packet. MPR set of every node contains its symmetric one hop neighbors through which all its two hop neighbors can be reached. In OLSR protocol working depends on Multi Point Relay, instead of broadcasting packet by all the nodes only Multipoint Relay (MPR) nodes broadcast route packets. Each node in the network keeps a list of information provides by MPR nodes and stores it in routing table. This MPR selector is obtained by sending HELLO packets between in neighbor nodes within range of that node only neighbors. To send a message to a particular destination these routes are established before any source node intends. Each and every node in the network keeps a routing table and information is updated periodically. This is the reason the routing overhead for OLSR is minimum than other reactive routing protocols and it provide a shortest route to the destination in the network. As the existing in use route does not increase enough routing overhead because every node already build, so there is no need to build the new routes. OLSR reduces the route discovery delay. The HELLO messages is consist of all the neighbor information store in routing table. This enables the mobile node to have a table in which it has information about its entire multiple hop neighbors [5].

A node selects minimum number of MPR nodes. Topology control (TC) messages are broadcasted by these nodes which is having information about link status at predetermined TC interval. TC messages is also used to calculate the routing table's information and update it periodically [5].

b) PUMA:

It is a receiver initiated routing protocol in which receivers join a multicast group using one special address. By using this special address (core of the group) the flooding of data packet or control packets is reduced by all sources. By using Distributed algorithm core among receivers of a multicast group is elected. To find loop-free shortest path between the core and group members election algorithm is used which is same as the spanning tree algorithm. The elected core is connected to receivers through all possible shortest paths in the network. All neighbor nodes on shortest paths collectively form the mesh structure. Data packets are sent from sender to the group via core along any possible shortest path and flooded within the formed mesh whenever mesh member receives. Packet ID cache is maintained in all nodes in the network to remove data packets that are duplicated [8].

IV. SIMULATION SETUP

In this project, we used NS2 (Network Simulator version 2) as our simulation tool to simulate Video over Ad-Hoc network. We analyse and compared the performance of two routing protocols, considering various node density scenarios. To simulate realtime multimedia traffic, sender sends MPEG4 data packets over UDP as its transport protocol. Here, Random waypoint Mobility is applied to the nodes

Simulator	Network Simulator (NS2)	Network Simulator (NS2)
Routing Protocol	OLSR	PUMA
Total Nodes	5,10,15,20,25	5,10,15,20,25
Simulation Time	15 Sec	15 Sec
Simulation Area	1000m×1000m	1000m×1000m
Propagation Model	Two Ray Ground Model	Two Ray Ground Model
Mobility Model	Random Waypoint Model	Random Waypoint Model
MAC Protocol	MAC_802.11	MAC_802.11
Data Rate	11Mbps	11 Mbps

Mobility Speed	0-100 m/s	0-100 m/s
Traffic Type	MPEG4	MPEG4

V. SIMULATION RESULTS

The traces that were recorded for the simulation were utilized to calculate the parameters. Traces were analyzed by increasing the density of nodes. Also by varying mobility speed from 0 to 100m/s with step size of 20 m/s traces were analysed 1] Throughput(Kbps) 2] Packet Delivery Ratio(%)3] End to End Delay(ms) 4] Total Energy Consumption(Jules)

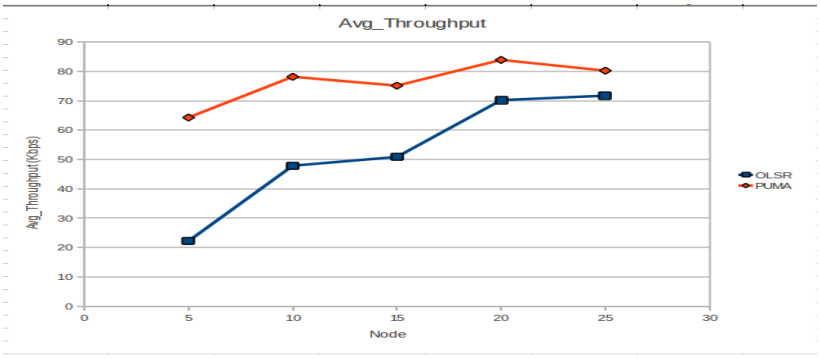

Fig 1.Average Throughput Vs No of Nodes

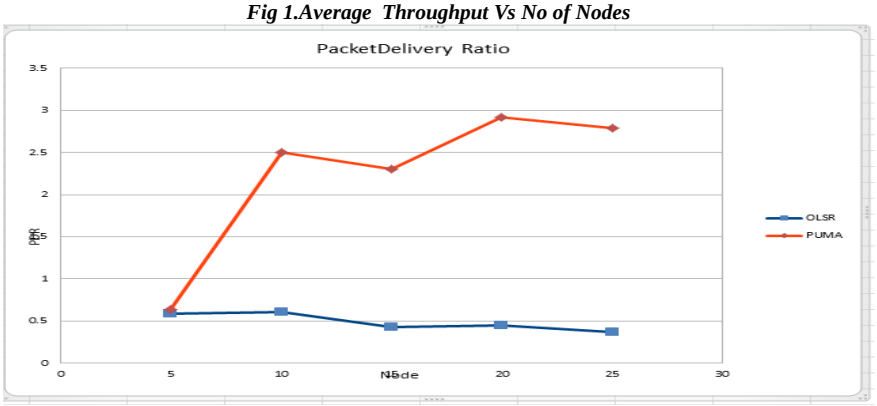

Fig 2. Packet Delivery Ratio Vs No of Nodes

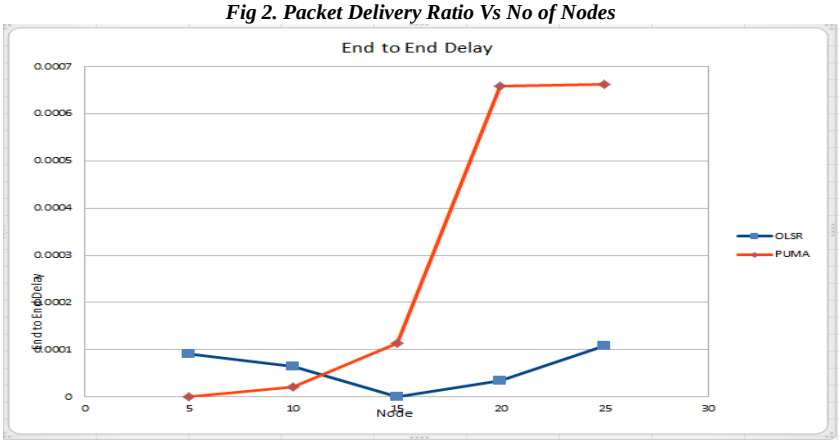

Fig 3. End to End Delay Vs No of Nodes

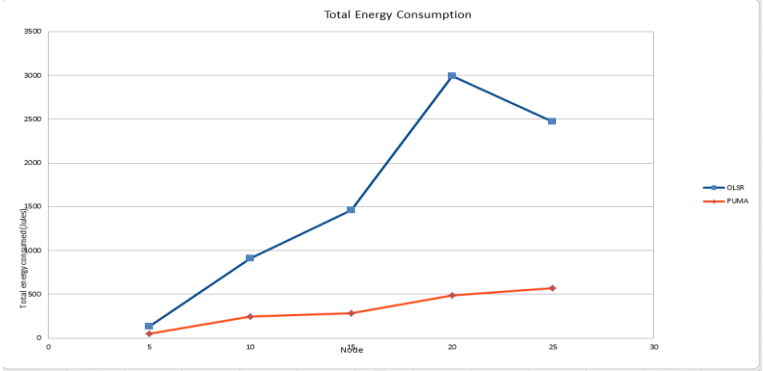

Fig 4. Total energy Consumption Vs No of Nodes

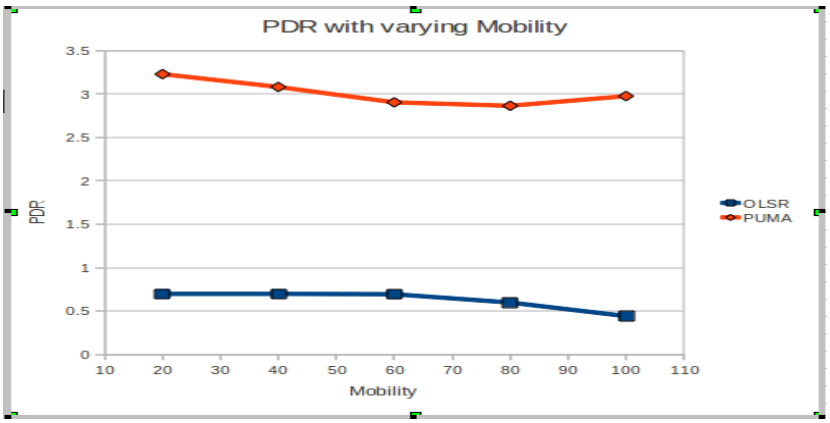

Fig5. PDR with varying Mobility speed

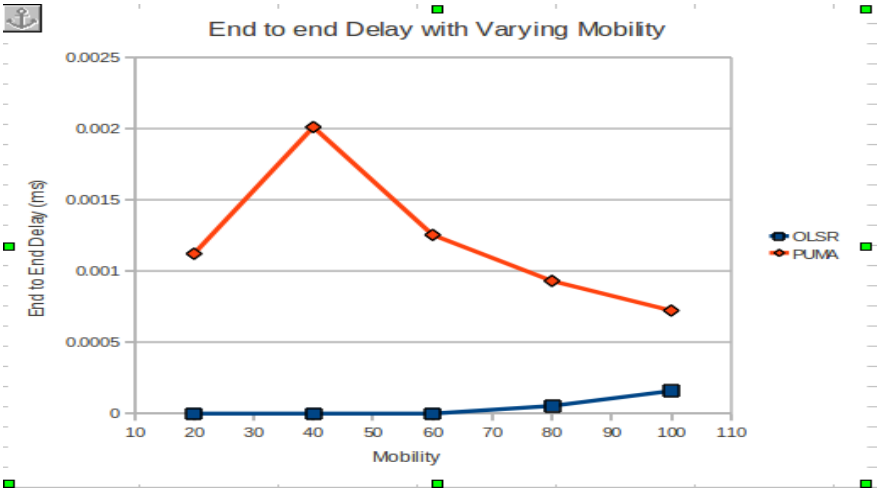

Fig 6. End to End Delay with Varying Mobility Speed

a) Discussion:

End to end delay analysis based upon the average end to end delay recorded over the entire length of simulation. The same approach was used for both the protocols. End to end delay values recorded for PUMA are lower for lower group size but as soon as group size increases end to end delay increases where as in OLSR as soon as group size increases delay decreases. Hence OLSR outperforms as it delivers lower end to end delay values than PUMA and delay is considered important aspect in multimedia communication.

Referring to Fig 1 for throughput values it is observed that both the protocols throughput performance increases in density of nodes but PUMA outperforms better each time. From fig.4 total energy consumed by network in OLSR is very high compare to PUMA. Since system always needs less energy consuming network PUMA is considered better for this.

PUMA outperforms OLSR with respect to the metrics like Throughput, packet delivery ratio and Energy consumption. This is because the per-source flooding in OLSR leads to significant number of packet drops due to congestion when the number of senders is increased beyond 10. while the only node that floods the network in PUMA is the core node. It is also observed that, when the number of multicast groups is increased, per source flooding per group leads to congestion and packet drops [8]. While end to end delay parameter OLSR delivers better results.

VI. Conclusion

In this work, The Multimedia element i.e. video was encoded using Suitable Video Coding and streamed through the multicast network. Performance analysis was done and the quality metrics like End to End Delay, PDR, Throughput and Energy Consumption were calculated and analyzed. It was also noticed that PUMA performs better in networks considering terms of Packet delivery ratio, Throughput and energy consumption parameters. And OLSR gives better results for end to end delay. Hence in over all PUMA is better used for multimedia streaming.

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