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Performance Evaluation of IARP, IERP, AODV, DSR and DYMO Routing Protocols Based on Different Performance Metrics

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Abstract

Ad hoc network is a special type of mobile wireless network where a collection of mobile devices form a temporary network without any aid of an established infrastructure. The mobile nodes with wireless radio interface are connected by wireless links where each device is free to move independently and randomly. There are number of routing protocols in ad-hoc network area but it is not easy to decide which one is efficiently best. In this research paper, ZRP component protocols IARP and IERP and three on demand routing protocols AODV, DSR and DYMO based on IEEE 802.11 have been analyzed and compared in this paper. Comparative performance evaluation has been done based on performance measuring metrics jitter, end-to-end delay and throughput with MAC and physical layer model.
A scenario is set up for simulation to evaluate the performance of routing protocols IARP, IERP, AODV, DSR and DYMO. Simulation has been done for number of times with different values of pause time ranging from 0 to 100 seconds for all routing protocols. The data is collected for four metrics; Jitter, End to end delay and Throughput. Experimental results have been carried out by using simulation tool QualNet (version- 7.1) [1] and excel graph which is used for preparing the graphs from the data collected for different metrics.

Keywords: Jitter, End to end delay, Throughput, IARP, IERP, AODV, DSR, DYMO, QualNet 7.1.

1. Introduction

An ad hoc network is the cooperative engagement of a collection of mobile nodes without the required intervention of any centralized access point or existing infrastructure. Ad-hoc network has its unique characteristics such as, lack of central authority, frequent topology changes, rapid node mobility, shared radio channel and limited availability of resources. A number of protocols have been proposed for efficient routing in order to get more efficient information or data packet transfer during communications. However, it is difficult to decide which routing protocol is better according to a performance metric. In this paper we investigate the comparative performance of five protocols for ad hoc networks and proper graphs have been drawn using Microsoft office excel which shows relative performance of all protocols together based on a performance metric. We have analyzed the results for our simulation scenario, considering their effects on jitter, network latency (end-to-end delay), throughput and routing efficiency (packet delivery ratio).The mobile nodes with wireless radio interface are connected by wireless links where each device in a MANET is free to move independently and randomly with capability of changing its links to other devices frequently. It is a multi-hop process because of the limited transmission range of energy constrained mobile nodes and thus each device in network topology acts as a router. With dynamic nature of network topology the routes change very frequent [7] and so the efficient routing protocols plays important role to handle this problem. They should be capable of delivery of maximum number of packets safely to their destinations. Mobile ad-hoc networks are also capable of handling topology changes and malfunctions in nodes through network reconfigurations. The mobile ad-hoc networks are very flexible and suitable for several types of applications, as they allow the establishment of temporary communication without any pre configured infrastructure.

2. IARP

Intra-zone Routing Protocol (IARP) [2], a limited scope proactive routing protocol used to improve the performance of existing globally reactive routing protocols. With each node monitoring changes in its surrounding R-hop neighborhood (routing zone), global route discoveries to local destinations can be avoided. When a global route search is needed, the IARP's routing zones can be used to efficiently guide route queries outwards rather than blindly relaying queries from neighbor to neighbor. The proactive maintenance of routing zones also helps improve the quality of discovered routes, by making them more robust to changes in network topology. Once routes have been discovered, IARP's routing zone offers enhanced, real-time, route maintenance. Link failures can be bypassed by multiple hop paths within the routing zone.

3. IERP

This document describes the Interzone Routing Protocol (IERP) [3], the reactive routing component of the Zone Routing Protocol (ZRP). IERP adapts existing reactive routing protocol implementations to take advantage of the known topology of each node's surrounding R-hop neighborhood (routing zone), provided by the Intrazone Routing Protocol (IARP). The availability of routing zone routes allows IERP to suppress route queries for local destinations. IERP adapts existing reactive routing protocol implementations to take advantage of the known topology of each node's surrounding R-hop neighborhood (routing zone), provided by the Intra zone Routing Protocol (IARP).

4. AODV

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a Reactive routing protocol AODV only needs to maintain the routing information about the active paths [4]. Routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way.

5. DSR

The dynamic source routing protocol (DSR) is an on demand routing protocol. DSR is simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes [5]. Using DSR the network is completely self-organizing and self-configuring requiring no existing network infrastructure or administration.

6. DYMO

The Dynamic MANET On demand (DYMO) is a reactive or on demand, multihop, unicast routing protocol that not update route information periodically [6]. The DYMO is a small memory stores routing information and generated Control Packets when a node receives the data packet from route path.

7. Simulation Setup and Results

The Qualnet 7.1 network simulator has been used for the analysis. The pause time is varied from 0-100s at the interval of 20s and data has been collected for all considered metrics that is jitter, end to end delay and throughput. This simulation runs 6 times and total 30 times with different values of the pause time ranging from 0 to 100 seconds for each protocol. The following table gives some details on the settings used in experiments.

Table I: Parameter Setup for Simulation.

Parameter	Value
Simulation tool	QualNet (Version 7.1)
Area	1500 m * 1500 m
Maximum Speed	20 m/s
Traffic Type	CBR
Simulation Time	500 Second
Pause Time	0, 20, 40, 60, 80, 100
MAC Layer Protocol	IEEE 802.11
Mobility Model	Random Way Point

7.1 Jitter

This is distinction of the packet arrival time that is packet arrival times are different. It is an important metric for any routing protocol. The figure 1 shows results of jitter for all five protocols. In this analysis with the varying pause time, it is observed DSR has largest jitter for smaller pause time and IERP for has higher jitter for larger pause time. AODV and DYMO have satisfactory jitter. IARP has lowest jitter value throughout the pause time variation.

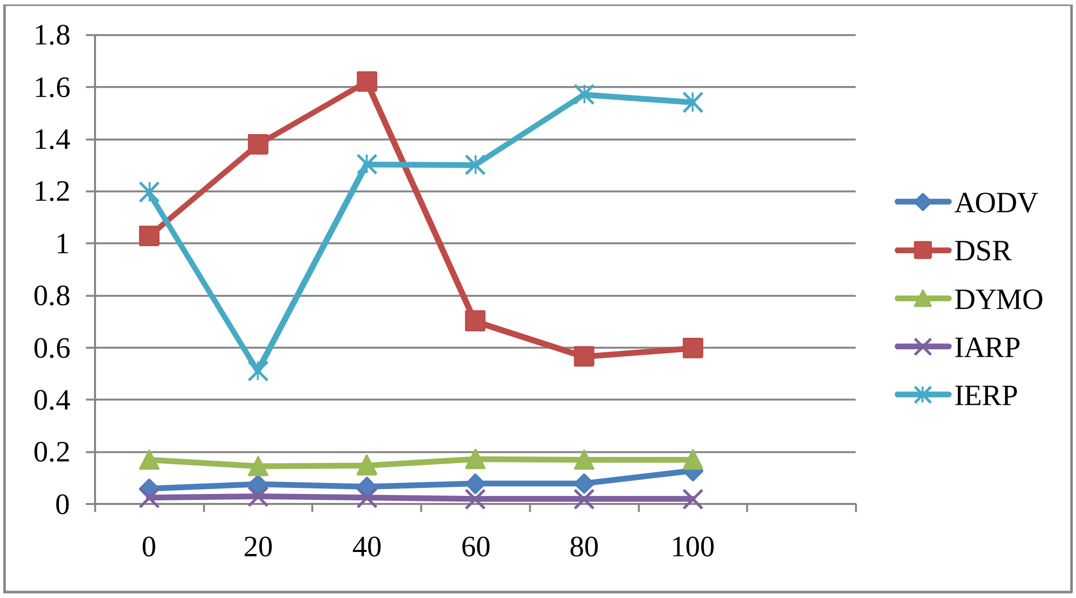

Fig. 1: Jitter (sec) Vs pause time (sec)

7.2 Average End-to- End Delay

This is the average delay is time interval between the sending of the data packet by the CBR source and its receipt at the corresponding CBR receiver. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC and propagation and transfer times.

From the result, shown in figure 2, we observed that IERP has highest end-to-end delay almost all over the pause time variation followed by second higher end-to-end value which corresponds to DSR. AODV and DYMO both have very low values all over the pause time variation although AODV has slightly lower values than DYMO all over variation of pause time. And at last IARP is one which has lowest end-o-end delay variation throughout the variation of pause time.

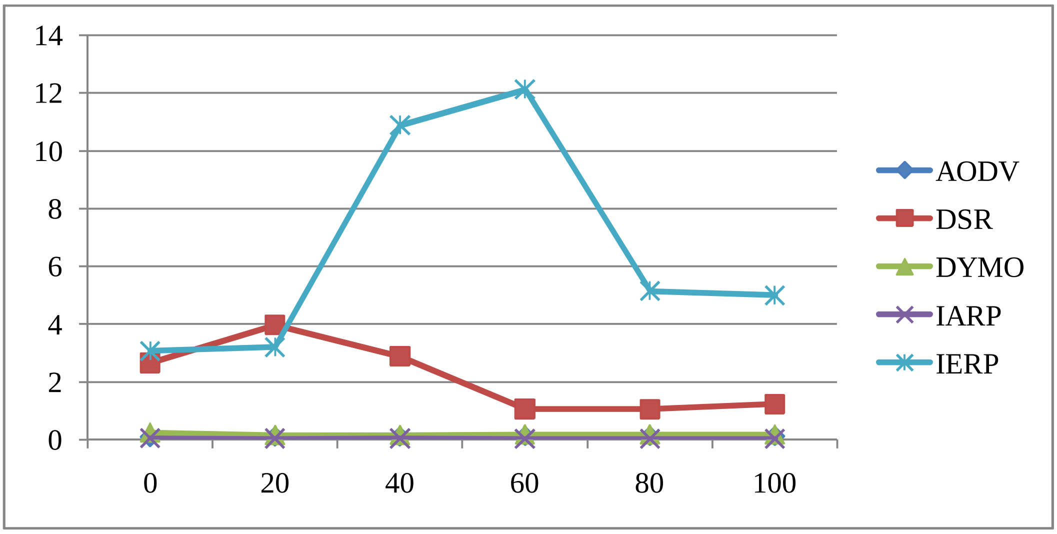

Fig. 2: End-To-End Delay Vs Pause Time.

7.3 Throughput

Throughput is the average rate of successful message delivery over a communication channel. With the varying pause time the throughput has been analyzed.

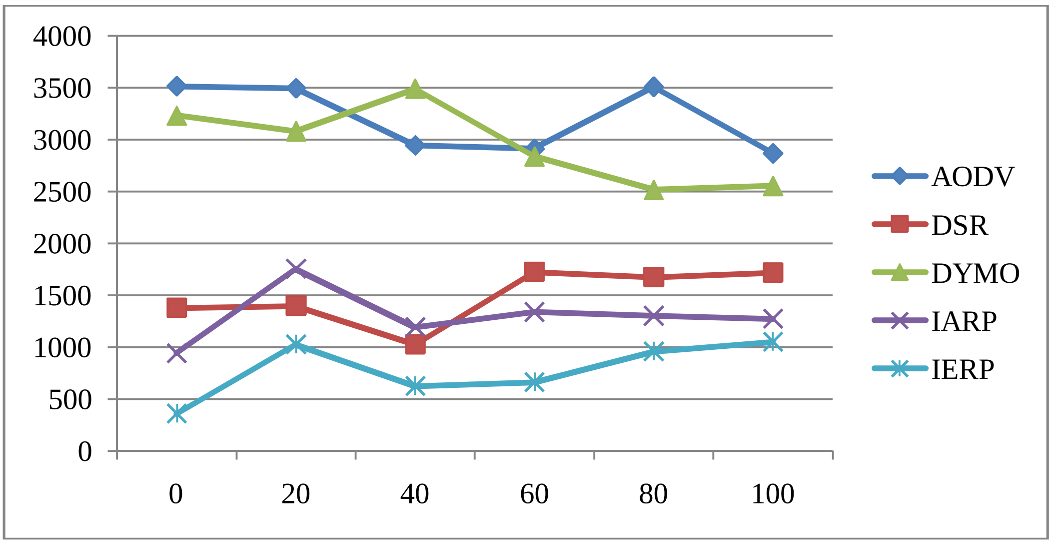

Fig. 3: Throughput Vs pause time.

It is found that DYMO performs better than all other remaining routing protocols for average pause time values but for initial and end pause time values AODV has better throughput values than all other remaining routing protocols. In routing protocols other than AODV and DYMO two routing protocols DSR and IARP has nearly similar throughput values although on average DSR has slightly more throughput overall. IERP is one which has least throughput values all over pause time variation.

8. Conclusion

We have analyzed results which show AODV and DYMO performs better than all other routing protocols and more precisely, it is AODV which is better than all. However for jitter and end-to-end delay metrics, it is IARP which performs better than other remaining routing protocols. Now further we can analyze the results for more number of metrics in order to get better idea about performance of routing protocols. Even we can talk additional issues of ad-hoc networks like security issues under comparison criteria.

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