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Performance Analysis of Traffic Patterns over MANET Routing Protocols in Zigbee Personal Area Network

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***Abstract*– Mobile ad hoc network is a network technique, which connects two or more mobile computers with each other without existence of a central point of contact, and without any network server, which is the role of each point, pass packets to other branches of the network. The proposed work is to attempt to identify the performance of data traffic patterns (CBR, FTP and POISSON) in Zigbee personal area networks (PAN) using MANET routing protocols (AODV, DSR and INTANTSENSE). Simulation and computations of data loss, overhead, throughput, PDR and delay done using NS2 simulator (Version 2.34) with parameter of quality of data and pause time.**

***Index Terms*– Routing Protocols, DSR, AODV, INTANTSENSE, Traffic Patterns, FTP, CBR, POISSON, Bluetooth Zigbee and WPAN**

I. INTRODUCTION

MANET is a network represented as a wireless network consists of mobile nodes dynamically self-organized in arbitrary and temporary network topologies. Mobile Ad-hoc nodes maybe a people's digital assistant, computers and vehicles work in areas without infrastructure nodes existent. On the other hand, MANET takes place when the use of such infrastructure requires wireless extension [1]. In the mobile ad hoc network, nodes can directly communicate with all the other nodes within their radio ranges; whereas nodes that not in the direct communication range use intermediate nodes to communicate with each other. In recent years most researches focusing in the concept of ad hoc network especially in MANET that because of the importance of these networks in many applications. the problem that facing this networks is the dynamic nature of the nodes, which leads to high losses and poor quality , so the challenges is how to choose the optimal routing protocol that can be used with most usable data traffic pattern to ensure low delay, low overhead and high PDR to obtain a good QoS of these networks [2].

II. ROUTING PROTOCOLS

A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks [3]. These protocols find a route for packet delivery and deliver the packet to the correct destination.

A. DSR Protocol

DSR is an On Demand routing protocol, it based on the concept of source based routing strategy and it is a simple and efficient routing protocol designed for use in multi-hop wireless Ad hoc networks of mobile nodes.

B. AODV Protocol

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. AODV is capable of both unicast and multicast routing. It is an on demand algorithm, which build routes between nodes only as desired by source nodes. It maintains these routes as long as they needed by the sources [3]. AODV uses sequence numbers to ensure the freshness of routes. It is loop free, self-starting, and scales to large number of mobile nodes an improvement of DSDV protocol essentially a combination of both DSR and DSDV protocols.

C. INTANTSENSE Protocol

Intelligent Mobile Ad-hoc routing protocol is a new protocol uses the same mechanisms of pervious Ad-Hoc on demand distance vector (AODV) routing protocol, the same features of reactive routing algorithm route discovery and route maintenance based on Ant Colony Optimization named Intelligent Ant Sense, and it depends on pheromone value which is used to control routing process for route discovery, during route maintenance and failure handling [3].

In Intelligent Ant Sense protocol, each route in nodes routing table assigned a pheromone value to represent the quality of the route, measuring the cost and efficiency of chosen path from source to destination. The pheromone value depending on the number of hops the forward ant needed to

reach the node. At each node, the initial pheromone value calculated based on the information collected by the ant and these values assigned to the route entry in the nodes routing table for route establishing.

III. TRAFFIC PATTERNS

The traffic model describes the way that governs the process of how a number of packets arrived to nodes on the network. Three commonly used traffic arrival distributions are used which each generate a mean of one packet per slot [4]. These traffic pattern models are CBR, FTP and Poisson, which they are the most common traffic patterns used in the networks.

A. Constant Bit Rate (CBR)

The Constant Bit Rate (CBR) Traffic CBR is a real time traffic that consume and constant the sending rate, where the traffic sending rate is specified at the Peak Cell Rate (PCR) parameter [4], [5].

B. File Transfer Protocol (FTP)

File Transfer Protocol (FTP) is a standard mechanism provided by the Internet for transferring files from one host to another. Well this is the most common task expected from a networking or an internet [6], [7].

C. Poisson

Another simplified traditional traffic generation model for circuit-switched data as well as packet data, is the Poisson process, where the number of incoming packets or calls per time unit follows the Poisson distribution. Analytical solutions for connection-oriented circuit switched voice networks, based on Poisson models, have been one of the most successful applications of mathematical techniques in this field [8].

This is possible because voice traffic spans long time scales and has the property of being relatively homogenous and predictable. Connectionless packet-oriented data traffic, found contemporary packet systems, on the other hand, is much more variable, since a typical multimedia application contains a mix of packets from various sources. Analysis of high quality traffic measurements confirms the prevalence of long-range dependent features and scaling in traffic processes loading packet switching communications networks.

IV. SIMULATION PARAMETERS

The simulation parameters, which have considered for doing the performance comparison of three on-demand routing protocols given in Table 1, and it represents all conditions of the networks simulation analysis.

Table 1: Simulation TCL file environment

Parameter	Value
Simulation area	50m * 50m
Distribution model	Random
Simulation time	100 sec
Transmission range	15 to 20 m
MAC Model	IEEE 802.15.4
routing Protocols	INTANTSENSE , AODV, DSR
Traffic Patterns	CBR,FTP,POISSON
Pause Time (sec)	10,20,30,40, 50,60,70,80 sec
Mobile Nodes	25 nodes

V. PERFORMANCE METRICS

The performance of any system needs to be evaluated on certain criteria, and then decide the basis performance of any system. Such parameters are known as performance metrics. The performance metrics used in the analysis to have a performance Of CBR, FTP and POISSON data traffic protocols over routing protocols in Zigbee personal area network. They are; Throughput, Packet delivery ratio, Data Loss, End-to-End Delay and Routing Overhead [9].

The simulation was run with parameters to describe the different situations in mobile Ad hoc network using pause time and these parameters used to ensure tests the robustness and scalability of the network with the tested routing protocols. The performance metrics are purposely chosen to show the differences in performance among the different routing methods. These metrics are the most crucial to measure the overall performance of the network routing algorithms. The performance was measured for overall network as the protocols was implemented over the network.

VI. RESULTS AND DISCUSSIONS

Through the data collected from the simulation, a statistical analysis was conducted to study the overall performance of CBR, FTP and POISSON then compare between them under routing protocols AODV, DSR and INTANTSENSE. Each of the output results collected from the various simulations gives a performance for the system when analyzed based on five parameters; end to end delay, throughput and packet delivery ratio, overhead and loss with respect to pause time, where pause time is considered as the time after which the node starts transmitting.

A. Scenario 1: CBR Performance Analysis

CBR traffic protocol scenario obtains a result of three protocols, AODV, DSR and INTANTSENSE Based on CBR over which was simulated under several pause times from 10sec to 80 sec with total simulation time of 100 sec.

For data loss in the simulation observed that in case of CBR traffic as shown in Fig. 1 the number of dropped data for AODV is observed to be lower than that of DSR and INTANTSENSE, that because when link fails, routing error is passed back to a transmitting node and the process repeats, as well as CBR provide the network with predictable response

time and a static amount of bandwidth continuously available for the life-time of the connection, but for DSR show the packet loss high because the route maintenance mechanism does not locally repair broken link, in INTANTSENSE more frequent event of dropped data through the simulation period at high mobility, because of many times of link updating due to the nodes moves from place to another one.

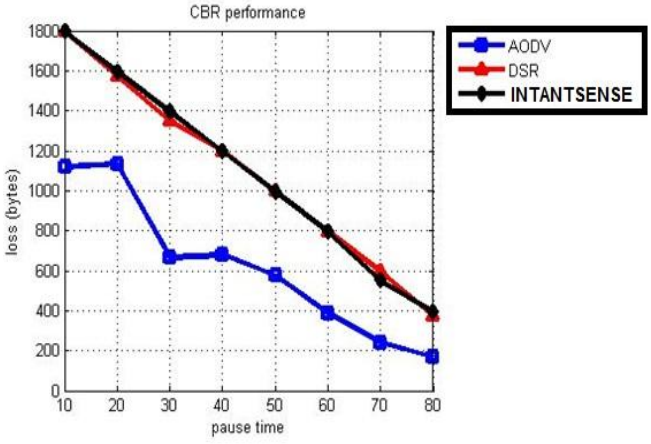

Fig. 1: Pause time versus Data loss in CBR traffic protocol

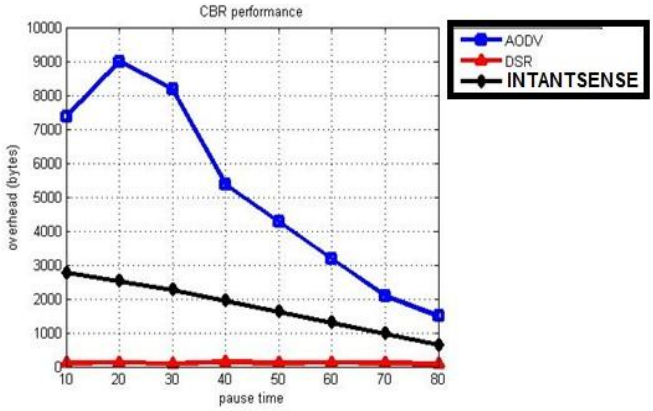

Fig. 2: Pause time versus overhead in CBR traffic protocol

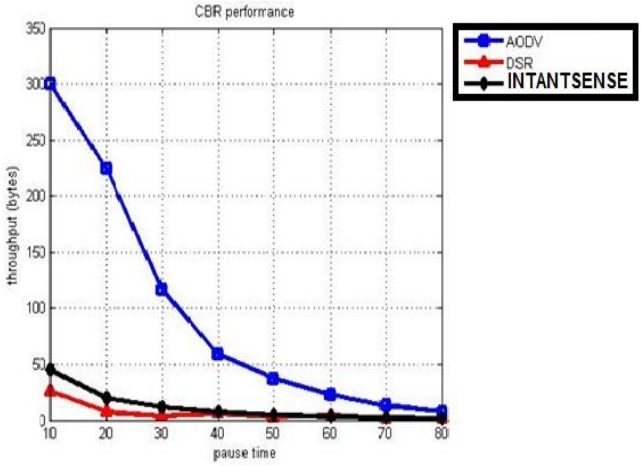

Fig. 3: Pause time versus throughput in CBR traffic protocol

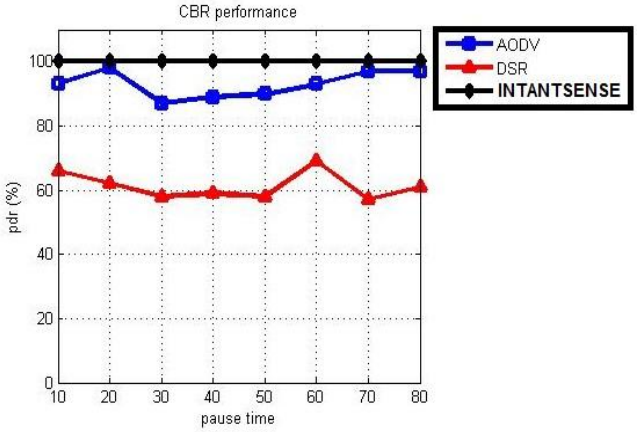

Fig. 4: Pause time versus Packet delivered ratio in CBR traffic protocol

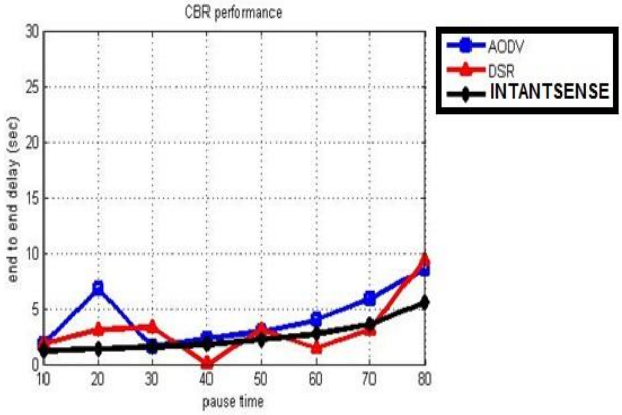

Fig. 5: Pause time versus end to end delay in CBR traffic protocol

Overhead in case of CBR traffic protocol as shown in Fig. 2 DSR has the best performance, because it's enables the source and intermediate nodes to use caching and snooping effectively to reduce the route discovery which cause overhead, whereas INTANTSENSE has routing overhead slightly higher than DSR because it uses adapting routing discovery when route is failed. The routing overhead for AODV is higher than INTANTSENSE and DSR because multiple Route Request packets in response to a single Route Request packet can lead to heavy control overhead.

Throughput According to our simulation results as shown in Fig. 3 better performance is shown by AODV it attribute to responds it very quickly to the topological changes that affects the active routes, whereas INTANTSENSE Performance better than DSR because its ability to search route quickly as it avoids expiring good route by updating route lifetime appropriately.

Packet delivered ratio the simulation observed that in case of CBR traffic as shown in Fig. 4 the performance of INTANTSENSE is better as compared to other two protocols with packet delivery ratio observed as 100%, because of a good route updating and availability of other routes due to the pheromone process swell as the effect of CBR traffic preserves constant bandwidth and minimizes the packets loss during transmission, but AODV gives packet delivered ratio

lower slightly than INTANTSENSE because when link fails, routing error is passed back to a transmitting node and the process repeats, but in DSR the performance is low because Stale route cache information could also result in inconsistencies during the route construction phase.

End to end delay shown in Fig. 5 AODV becomes higher than INTANTSNSE and DSR, because of long time required in AODV to discover a new route when current route was failed, DSR is nearby AODV performance because of low buffer space to manage the incoming data, but in INTANTSENSE there is another available path by multipath strategy can be used when failure occurred, there is no require generating a new route to take a few times delay.

B. Scenario 2: FTP Performance Analysis

FTP traffic protocol scenario gives a result of three protocols, AODV, DSR and INTANTSENSE Based on FTP which was simulated under several pause times from 10sec to 80 sec with total simulation time of 100 sec.

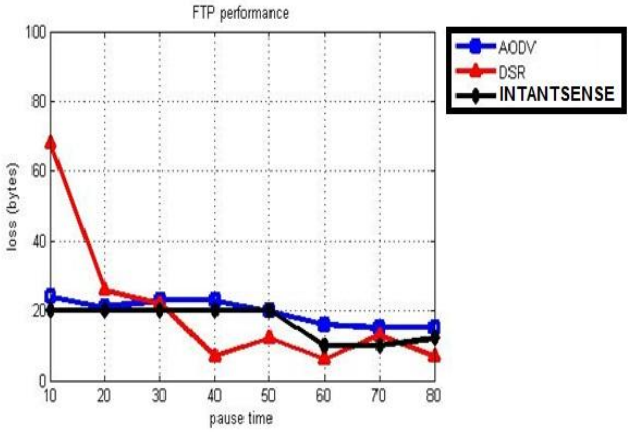

Fig. 6: Pause time versus Data loss in FTP traffic protocol

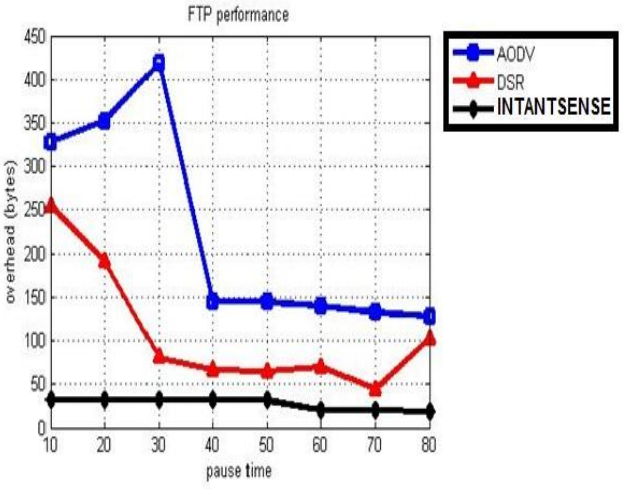

Fig. 7: Pause time versus overhead in FTP traffic protocol

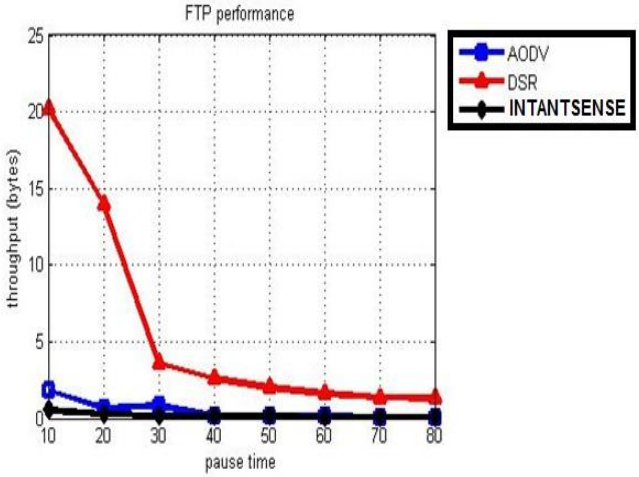

Fig. 8: Pause time versus throughput in FTP traffic protocol

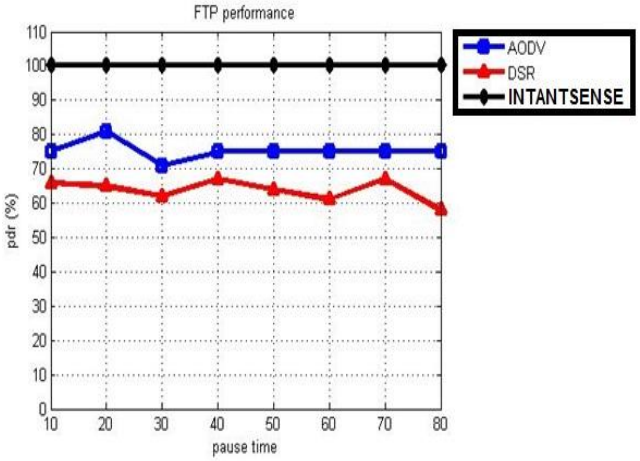

Fig. 9: Pause time versus Packet delivered ratio in FTP traffic protocol

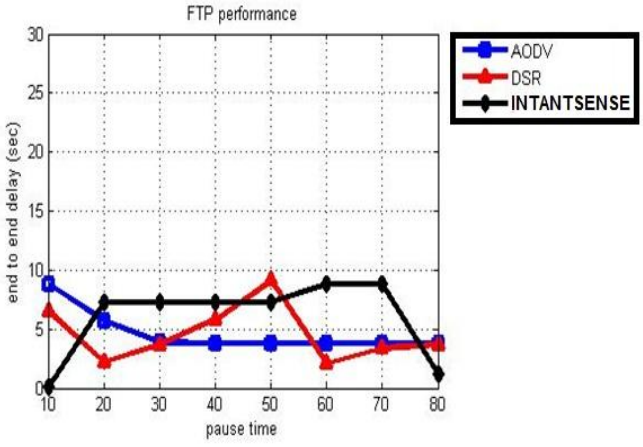

Fig. 10: Pause time versus end to end delay in FTP traffic protocol

Data loss in case of FTP as shown in Fig. 6 DSR protocol begin with a high value of loss because When mobility increases, more routes will become invalid and new requests

are necessary. While the requests are propagating the network in search for a new route, buffers will get full and packets are dropped then decrease when a pause time become increase, but AODV and INTANTSENSE performs better than DSR, begin with fixed value and then decrease when a pause time become increase.

Overhead According to our simulation results as shown in Fig. 7 better performance is shown by INTANTSENSE, whereas AODV is very higher than DSR and INTANTSENSE because of multiple route replies to a single route request, whereas DSR routing overhead is higher than INTANTSENSE because Routing overhead is involved due to the source-routing mechanism. The routing overhead is directly proportional to the path length.

Throughput in case of FTP traffic as illustrated in Fig. 8, DSR performs better because maintenance based on the link status can further reduce the number of dropped packets, but both AODV and INTANTSENSE gives almost similar performance lower than DSR.

Packet delivered ratio the simulation as shown in Fig. 9 the performance of INTANTSENSE is better as compared to other two protocols with packet delivery ratio observed as 100%, because of a good route updating and availability of other routes due to the pheromone process as well as FTP protocol allows to transfer multiple files and ability to resume a transfer is the connection is lost, whereas DSR and AODV have low packet delivered ratio than INTANTSENSE because they don't have mechanism to maintain the route when route failure occurs.

End to end delay in as shown in Fig. 10, AODV was observed to be better general increases from the beginning of the simulation then continuous with low and fixed value, delay in INTANTSENSE is very high although it have an alternate links which make it quickly discover a new route when failure occurred, but for FTP traffic, it is required that the routes for each connection this will increases the delay.

C. Scenario 3: POISSON Performance Analysis

POISSON traffic protocol scenario reviews a result of three protocols, AODV, DSR and INTANTSENSE Based on POISSON which was simulated under several pause times from 10sec to 80 sec with total simulation time of 100 sec.

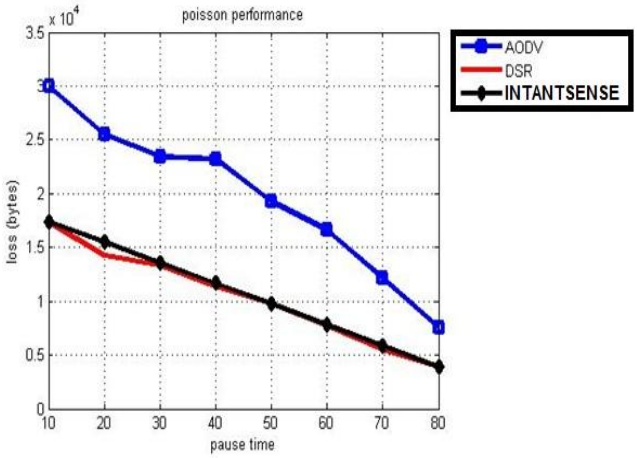

Fig. 11: Pause time versus Data loss in Poisson traffic protocol

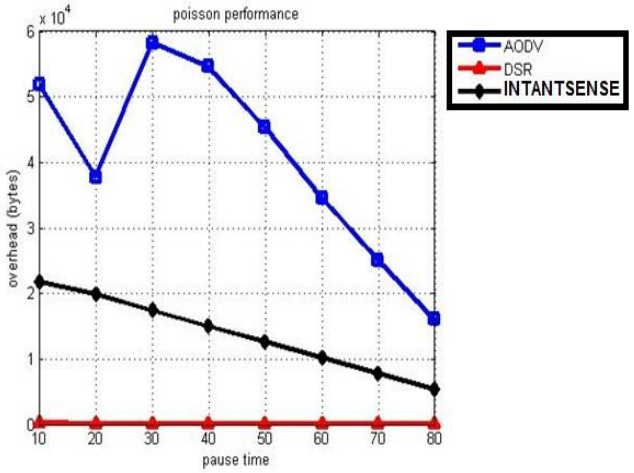

Fig. 12: Pause time versus overhead in Poisson traffic protocol

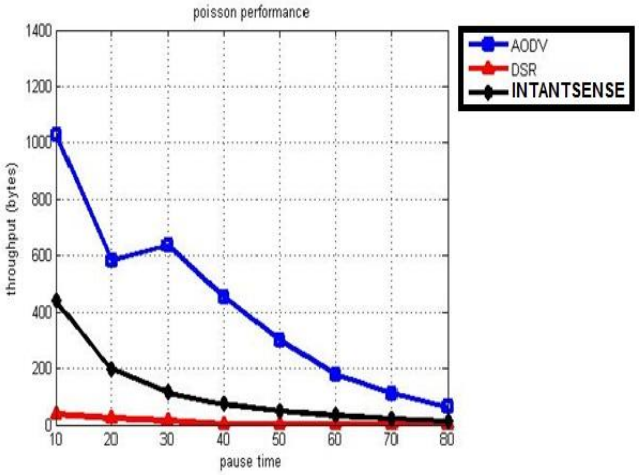

Fig. 13: Pause time versus throughput in Poisson traffic protocol

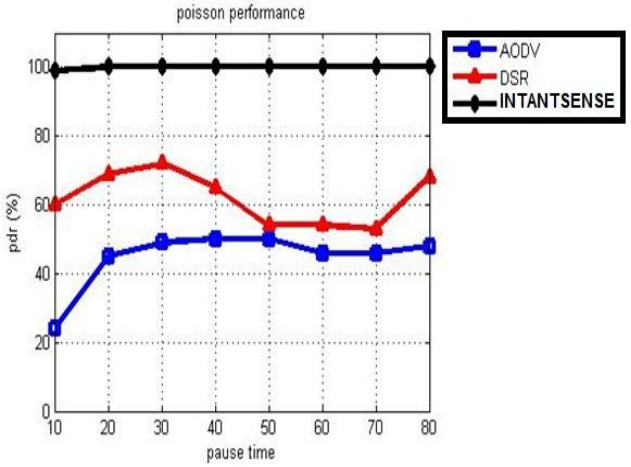

Fig. 14: Pause time versus Packet delivered ratio in Poisson traffic protocol

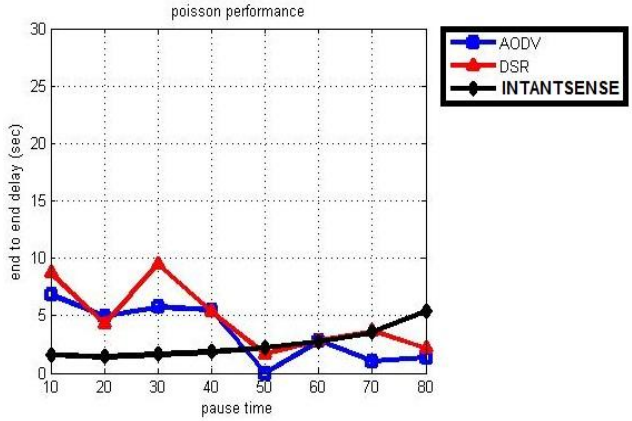

Fig. 15: Pause time versus end to end delay in Poisson traffic protocol

Data loss According to our simulation results as shown in Fig. 11 better performance is shown by DSR and INTANTSENSE the drop value increases at lower pause time and become lower when the pause time increases because the routes are broken quickly due to mobility of the routers, whereas in AODV the loss is very high because Poisson do with arrival times are independent and exponentially distributed.

For overhead as shown in Fig. 12 DSR has the low overhead because This can be attributed to the caching strategy used by DSR by virtue of aggressive caching, DSR is more likely to find route in the cache, and hence resorts to route discovery less frequently than AODV and INTANTSENSE, whereas INTANTSENSE has routing overhead slightly higher than DSR because it uses adapting routing discovery when route is failed. The routing overhead for AODV is higher than INTANTSENSE and DSR because relies on its route discovery process to establish new routes and repair broken routes, the larger number of connections results in considerably more work.

Throughput According to our simulation results as shown in Fig. 13 better performance is shown by AODV, whereas in DSR and INTANTSENSE the throughput value increases at lower pause time and become lower when the time increases because DSR is week as it doesn't have proper technique to update stale routs.

Packet delivered ratio the simulation observed that in case of Poisson traffics shown in Fig. 14 the performance of INTANTSENSE is better as compared to other two protocols with packet delivery ratio observed as approximately100%, because of a good route updating and availability of other routes due to the pheromone process, In lower mobility ,DSR often performs better than AODV, because the chances of find the route in one of the caches is much higher but in lesser simulation time and lesser mobility models, the better performance of DSR over AODV couldn't be observed.

End to end delay as shown in Fig. 15, INTANTSENSE has high performance, followed by AODV because network is less congested in the Poisson case, but DSR has higher delay this potential long delay the result of the routing information can be obtained by spending lot of time to process any control data it receives, even if it is not the intended recipient.

VII. CONCLUSION

In this paper ,evaluation of three different ad hoc data traffic protocol (CBR ,FTP and POISSON) with three Ad Hoc routing protocol(AODV,DSR and INTELEGENT) and comparison between them in routing overhead, packet delivery ratio, throughput and packet end to end delay .Through the performance analysis conducted in the previous chapter In a nutshell search protocol CBR showed less loss, as well as higher throughput with protocol AODV compared with other routing protocols and less overhead on the network was with protocol DSR either the proportion of the delay hardly be close, but with the lowest rate was INTANTSENSE. When use a file transfer protocol FTP found that the lowest rate of loss of data and the delay was with the use routing protocol AODV and better throughput with protocol DSR and less overhead on the network to be with INTANTSENSE. Poisson protocol showed a high percentage of loss data with all routing protocol, but the least of which was with DSR. And with less overhead on the network with DSR the highest throughput and emerged with AODV .An insight into the protocols performance and to standardize routing protocols for different network conditions. Yet many factors such as impact of multi speed network, power capacity of nodes, mobility model, and defective nodes in the network. Need to be considered to improve the performance of MANET. Evaluate the performance of different hybrid routing protocol with different application level traffics.

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