Investigation and Optimization of Hello Message Interval for Scalable Ad-Hoc Network

Shailendra Singh Tomer
M.tech student
Electronics & communication Department
MIT Bhopal

Achint Chugh
Professor & Head of department
Electronics & communication Department
MIT Bhopal

ABSTRACT
Mobile A d h o c Networks (MANET) has become an exciting and important technology in recent years because of the rapid proliferation of wireless devices. A mobile ad-hoc network alive of mobile nodes that can move freely in an open environment. Communicating nodes in a MANET usually seek the help of other intermediate nodes to establish communication channels. manet contain reactive protocols Aodv is one of popular protocol. Route failure due to motion of nodes and lack of battery power thus route maintance is an important issue .routing is an important function aspect in wireless ad-hoc network that handles discovering and maintaining the path beween nodes within a network.For route maintance the node periodically broadcast hello message to their neighbours.In aodv although benefits of these messages have been proven ,many study show some drawback for these message.In paper we optimize the hello interval with different hello loss 2 or 3.The simulation is done on Qualnet .Result analysis determine that Aodv perform better at HI=3 sec

Keywords
MANET,aodv protocol,hello message,hello interval

1. INTRODUCTION
Mobile Ad-hoc Network is a network without infrastructure, where every node works as a router. In this network, every node must discover its local neighbours and through those neighbours it will communicate to nodes that are out of its transmission range (multi-hop). These networks suffer from nodes mobility causes continual link breaks. This causes the routing protocol to use different techniques to update its knowledge about local neighbours, which is known as Local Connectivity organize (LCM). One of those techniques is periodically broadcasting short beacon messages (called hello messages). Although continual broadcasting the hello messages helped to get clearer view of the local network topology, it also produced some drawbacks for the whole inter connection in general. Rising number of these messages consumes the network resources and bandwidth, increases interferences with data and control messages, and utilizes the limited nodes battery life during sending and receiving operations[4,5,6,7]. On the other hand, the decreased number of hello messages results in time gap between link failure event and its identification. In reality , it means that, the protocol designer has to trade-off sending these messages carefully to represent the real needs for connectivity updating. In this study, we attempt to adaptively optimize the maximum time period that can transpire before the node broadcast the next hello message[1,2]. Optimization of this time directly affects the number of sent hello messages during a fixed period of time. Optimization is based on the correlation between the topology reconstruction and the periodical interval for the hello message transmission.

1.1 Overview of AODV
AODV is an on-demand routing protocol where routes are established only as required. When a route is required, it uses a route discovery process to understand a route. Once it confirm a route, it is maintained as long as it requires by a maintenance method. if a route is not in use, it lapse after a particular point [9,10,11,13]. It can use one of the two procedures for link failure detection: link layer feedback or beacon messages. Due to difficulty in obtaining link layer response, it uses beacon messages for ad hoc network as fig 1 & 9 shows.

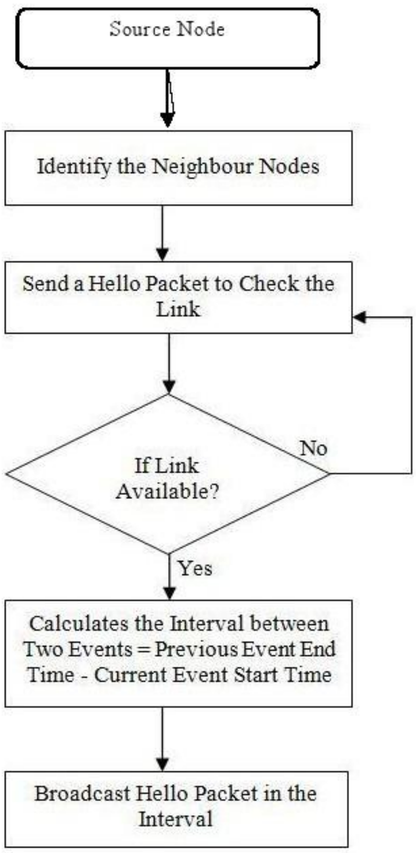


Fig 1: Flow diagram for adaptive hello messaging scheme[9]

i. Active route- A path towards a destination that has a routing table data that is checked as valid path. Only active routes can be used to forward data bundles.

ii. Relay- Relaying or Broadcasting means transmission of the Internet Protocol. A relayed data bundles may not be forwarded without knowing destination address, but Relaying is useful to enable scattering of AODV messages throughout the ad hoc network.

iii. Destination- An Internet Protocol address to which data bundles are to be transmitted. Same as "destination node". A node knows it is the destination node for a typical data bundles when its address appears in the correct field of the Internet Protocol header. Routes for destination nodes are supplied by action of the AODV protocol, which carries the Internet Protocol address of the destination node in route discovery messages.

iv. Feed Forwarding Point - A intersection that allows to forward bundles destined for another point, by retransmitting them to a next level that is closer to the unicast destination along a path that has been set up using routing messages.

v. Forward route- A route set up to forward data bundles from a point originating a Route Discovery operation towards its desired destination.

vi. Invalid route-A route that has no longer exist, denoted by a state of invalid in the routing table entry. An invalid route is used to hold previously valid route information for an time interval. An invalid route cannot be used to forward data bundles, but it can gives information beneficial for route organises, and also for future RREQ messages.

vii. Source point- A points that starts an AODV route discovery message to be processed and possibly retransmitted by other nodes in the ad hoc network. For sample, the node starting a Route finding process and relaying the RREQ message is called the originating point of the RREQ message.

viii. Backward route- A route set up to forward a reply (RREP) bundles back to the Source from the destination or from an intermediate point having a route to the destination.

ix. Sequence number- A monotonically increasing number maintained by each source node. In AODV routing messages, it is used by other nodes to determine.

2. LITERATURE REVIEW

Essam Natsheh et al.[5], Adaptive Optimizing of Hello Messages in Wireless Ad-Hoc Networks. They used fuzzy logic system to optimize the frequency of sending hello messages.

R.Gokila et al.[10], An Efficient Secure Data Transmission for Adaptive Hello Messaging Scheme in Manet.He used design decreases the energy consumption and delay without any major difference in throughput.

Ian D.Chakeres et al[6], have examined the effectiveness of hello messages for monitoring link status and found some influencing factors on the utility of these messages.

Perkins et al. [3], creators of AODV protocol, discussed the reasons for applying hello messages with AODV and presented some disadvantages for using these messages. They mentioned that they will investigate their ways to eliminate drawbacks of these messages. Hello messages frequency optimization can allow us to get its benefits and at the same time remove its disadvantages, which will be proven during this research.

Shaily Mittal et al [12], PERFORMANCE COMPARISION OF AODV, DSR and ZRP ROUTING PROTOCOLS IN MANET'S. according them AODV shows best results in measuring end to end delay and packet delivery ratio.

Satish K. Shah et al. [11], Development and Simulation of Artificial Neural Network based decision on parametric values for Performance Optimization of Reactive Routing Protocol for MANET using Qualnet.

P. Divya1 et al.[9], An Adaptive Hello Messaging and Multipath Route Maintenance in On-Demand MANET Routing Protocol by reduce battery drain through practical suppression of unnecessary Hello messaging. presented. The proposed mechanism depends on using a history table to record the topology changes and according to the frequency of these changes the announcement rate is calculated.

Lundgren et al. [7] have provided evidence that the unreliable implementation of hello messages can lead to a systematic mismatch between the route state and the actual connectivity status. This field of mismatch is defined as "communication gray areas ". In such areas, data bundles cannot be transfer to each other . although the beacon messages indicate neighbor reachability.

Teresa Albero-Albero et al.[13] Salvador Santonja-Climent, Víctor-M.Sempere- Payá, JordiMataix-Oltra,"AODV Performance Evaluation and Proposal of Parameters Modification for Multimedia Traffic on Wireless Ad hoc Networks

2.1 Comparison of Protocols

Though table 1 AODV has good throughput than OLSR and DSR because of promiscuous listening and aggressive route caching policy always has an edge in high density network. AODV is better than DSR because AODV replies too the first arrived RREQ packet and discard other RREQ which arrive later from other source. In DSR, during data transfer, ip address of each node added successively, hence making jitter time to rise. On the other hand AODV has no such problem and hence has low jitter delay. Furthermore ,Aodv suites application where End to End to End delays are very critical. As a reactive protocol AODV transmits network information only on demand. The finite proactive part is the route maintenance (hello message).the AODV protocol is loop free and avoid the counting to infinity problem by the use of sequence numbers. This protocol offer quick adaption to mobile network with low processing and low bandwidth utilization fig 2 to 8 simulation results show comparatively of routing protocols easily .The number of data bytes successfully send to the receiver end during a particular amount of time is indicate throughput .& the ratio of the number of delivered data bundles to the destination. This gives the level of delivered data bundles to the destination known as packet delivery fraction.

Table 1 Scenario 1(fig 8) for comparison of protocols

PARAMETERS	TYPE
terrain	1500X1500
Routing protocol	AODV,DRS & OLSR
Channel	Wireless
Packet size	512
Packet to send	5000
Traffic type	CBR
Radio propagation Model	Two Ray Ground
Mobility model	Random waypoint
Number of nodes	30
Simulation time	300s

Fig 2:Qualnet Scenario 1

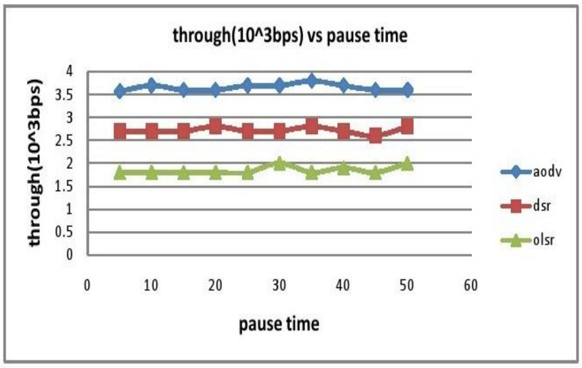


Fig 3: Throughput effect on pause time

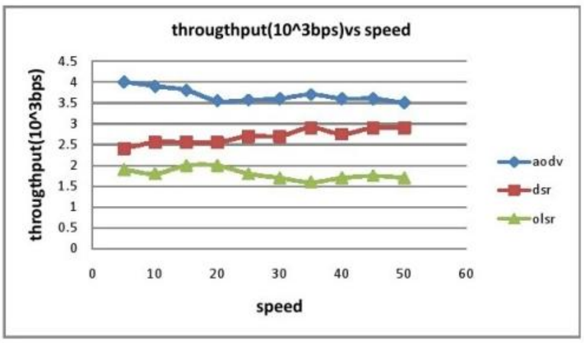


Fig 4: throughput effect vs Speed

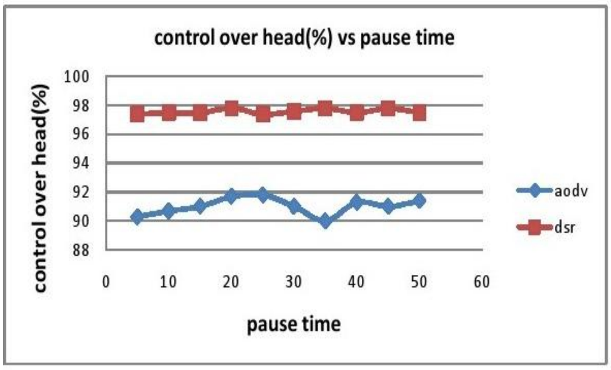


Fig 5: control over head effect on pause time

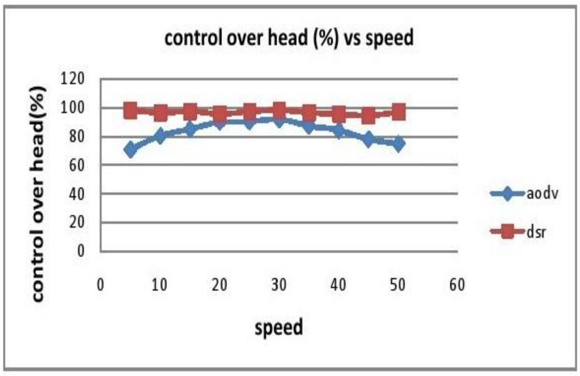


Fig 6: control over head effect on speed

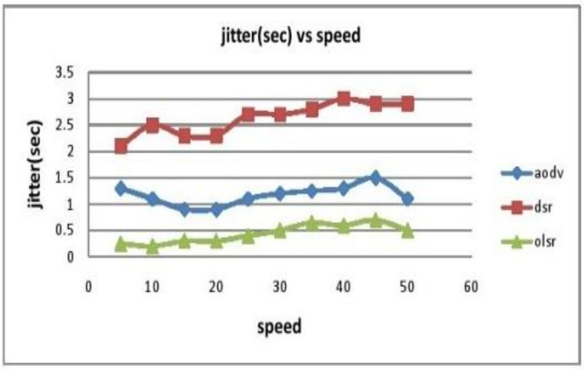


Fig 7: jitter effect on speed

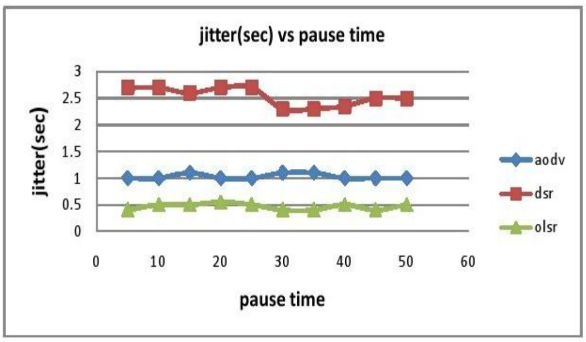


Fig 8: jitter effect on pause time

4. METHODOLOGY

A node determines connectivity information by listening hello messages from its set of neighbours. A node should use hello messages only if it is part of active route.

In this section we first present our network model and then formulate optimization hello interval for scalable ad-hoc network . We consider aodv, dsr & olsr protocols under MANET operating within random network topology and random work station . Work station mobility follows a model, there are many mobility models used in the evaluation of AODV protocol. The random waypoint model is one the most commonly used mobility models for simulations of protocols. In this model, each node selects a random destination, uniformly distributed within the two-dimensional space . In conventional hello messaging scheme before a packet is sent, status of neighbour nodes should be recognized first so as to recognize if there is a link failure with one of its neighbouring workstation. If the workstation moves to an area where no active nodes are in its neighbourhood, then nodes keeps broadcasting beacon messages and due to this unnecessarily energy consumption takes place. So if we choose best comfortable protocol which give u better throughput quick response we found aodv is best one by comparing AODV DSR & OLSR protocols which we can show by given results by graphs (fig 2 to 7). Now the efficiency of Aodv can be better than by default value by optimizing hello interval in hello message under different speed & pause time in aodv by default hello loss value is 2 but it can we 3 for optimization of aodv.value could not be beyond 2 or 3 . The maximum interval of time between the transmissions of hello messages is hello_interval. , time during which the node should assume that link is currently broken is the time if a node does not receive any packet from that node within the given time i.e. tfd = (allowed_hello_loss)*(hello_interval). (1)

by default, allowed_hello_loss is equal to 2 and hello_interval is equal to 1^3 ms i.e. 1 sec for aodv . now in the dynamic hello messaging scheme the time for link failure detection (tfdd) is given as:

tfdd = (allowed_hello_loss-.5)*(hello_interval) (2)

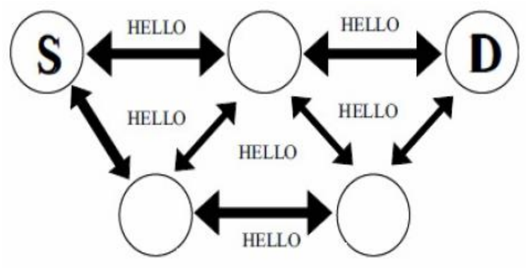


Fig 9: routing process in aodv protocol

First by using table 2 we check it without hello message (means 0 second hello interval) it give best result but it is not practically possible due to drawback like economic factor, battery or uncertainty behaviour of node ,power etc .then check it with hello message [hello message status- yes, beacon interval= (1 sec, 1.5 sec, 2sec, 2.5 sec, 3 sec)].If the value of hello interval goes down or we used fuzzy logic or any artificial interval for minimize hello interval the unnecessary number of hello massage are increase nodes continuously send message that by load or traffic is increase that effect communication.Here idea is to optimize adov by changing value of hello interval it could be 0 to 3 second the result can analysis by given graphs & data which is obtain by using QUALNET SIMULATOR in different scenario.fig (10,11,12) show running stage model of simulation in different mode.

5. RESULT & DISCUSSION

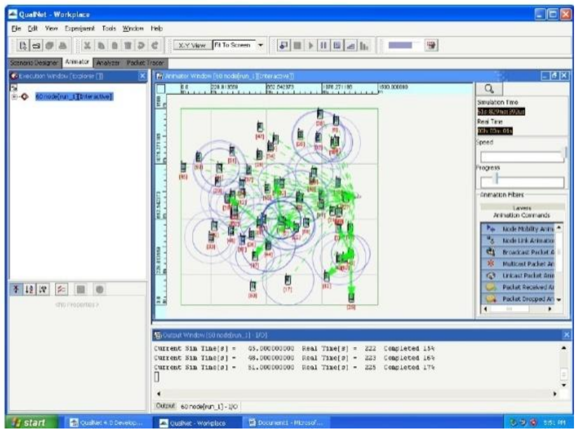


Fig 10: Qualnet Scenario 2

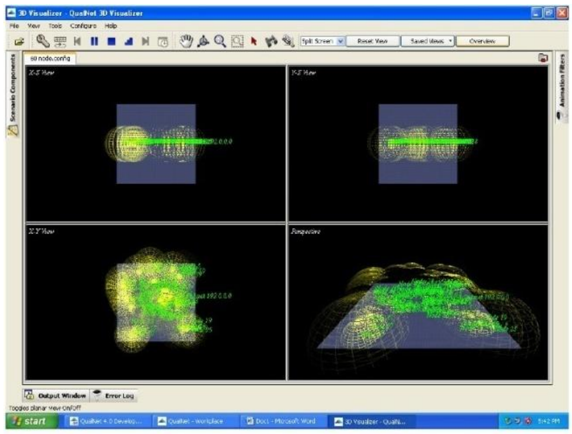


Fig 11: Animation Effect on active routing nodes

Packet Delivery Fraction-the ratio of the number of send data packet to the receiver end. This gives the level of delivered data bundles to the destination.

End point-to-End point Delay-the time taken by a data bundles to arrive in the receiver end. It also includes the delaying occured by path or route finding process and the queue in data bundles transmission. Only the data bundles that successfully send to destinations that counted.

Throughput-The number of data bytes successfully send to the receiver end during a particular amount of time (s).

Packet delivery ratio : the ratio of the number of delivered data bundles to the destination. This gives the level of delivered data bundles to the destination.

∑ Number of data bundles receive / ∑ Number of data bundles send

The more value of data bundle delivery ratio means the excellent performance of the protocol.

End point-to-end point Delay : the mean time taken by a data bundles to arrive in the destination. It also includes the delay caused by path or route discovery process and the queue in data bundles transmission. Only the data bundles that successfully delivered to destinations that counted.

∑ (arrive time – send time) / ∑ Number of connections

The lesser value of end point to end point delay means the good performance of the protocol.

Packet Lost : the total number of packets dropped during the simulation.

Packet lost = Number of packet send – Number of packet received .

The lesser value of the data bundles lost means the excellent performance of the protocol.

Control over head – it is the number if routing control packets sent by the protocol. sometimes expressed as a ratio of control to data .indication of how effectly a routing protocol operates

Control over head=[(RREQ+RREP+RERR)/(RREQ+RREP+RERR+DATA PACKETS)]*100

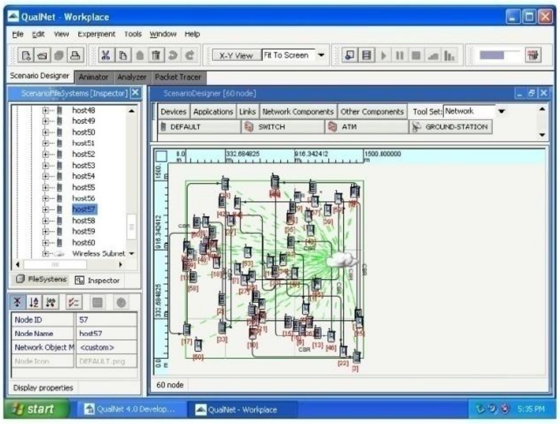


Fig 12: Qualnet running stage scenario 3

Table 2 Scenario for AODV hello message utilization with hello interval (0-3 sec)

PARAMETERS	TYPE
terrain	1500X1500
Routing protocol	AODV
Channel	Wireless
Packet size	512
Packet to send	6000
Traffic type	CBR
Radio propagation Model	Two Ray Ground
Mobility model	Random waypoint
Number of nodes	60
Nuber of cbr links	15
Simulation time	300s
allow hello loss	2 & 3

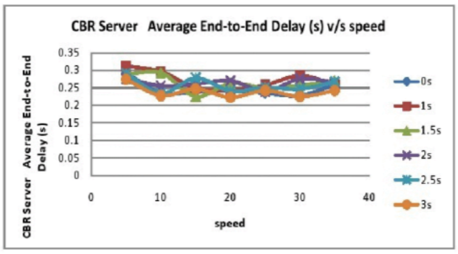
AODV is one the most important protocol reactive routing protocol which show these result in compare to other protocol Even AODV is best protocol but still its utilization limited for more improvement we change different value of different parameter of AODV here we discussing about hello message to make it adaptive utilization.

We check these results on cases below:

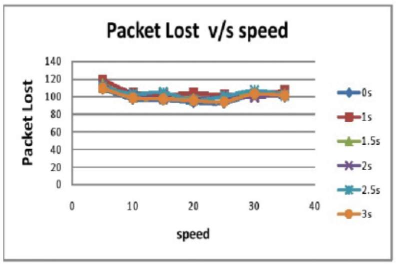
1. Low speed with constant pause time (50 s)
2. High speed with constant pause time (50 s)
3. Low pause time with constant speed (2 mps)
4. High pause time with constant speed (20 mps)

After t AODV Protocol gives best result on with hello message condition (mean hello interval 0 second) mean hello message are not active. But in with beacon message compare to (1 sec, 1.5 sec, 2 sec, 2.5 sec, 3 sec) these we observer hello interval 3 second that point AODV gives best result.fig 13 shows thses resuls according table 2 parameter

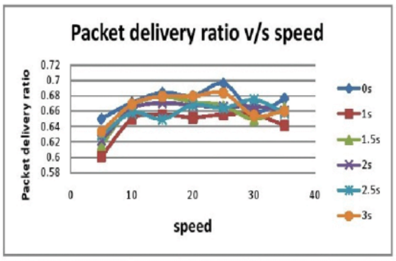
Note – we increase hello interval more than 3 second than hello message goes to zero means proper communication will not happened(means sent item = receive item =almost zero)



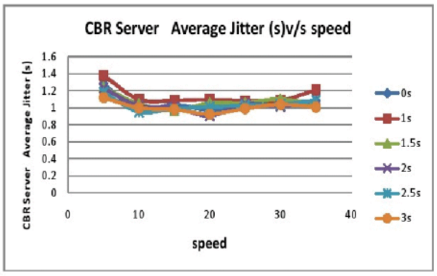
speed	0s	1s	1.5s	2s	2.5s	3s
5	0.291425	0.312149	0.288188	0.275693	0.289929	0.273444
10	0.235296	0.295803	0.292593	0.256053	0.233909	0.227582
15	0.238684	0.24956	0.225005	0.260352	0.277534	0.24683
20	0.2416	0.243579	0.262275	0.269795	0.24028	0.222725
25	0.234531	0.258346	0.248393	0.239291	0.250967	0.241823
30	0.22791	0.284107	0.257171	0.275307	0.245946	0.225035
35	0.258626	0.25957	0.268723	0.265029	0.267103	0.242123



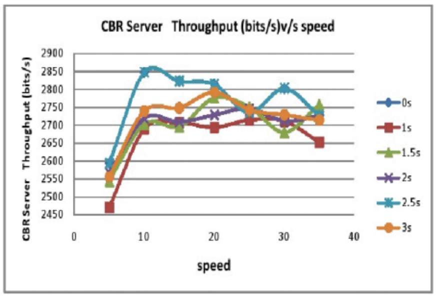
speed	0s	1s	1.5s	2s	2.5s	3s
5	108.6667	119.4	114.8667	112.9333	110.9333	109.6667
10	97.33333	104.7333	99.46667	100.8667	103.4	98.93333
15	96.4	103.0667	98.13333	98.46667	104.9333	97.73333
20	93.53333	104.1333	98.13333	97.46667	96.2	95.86667
25	92.86667	103	99.53333	100.1333	100.4667	94.53333
30	101.9333	103	104.8	99.66667	107.2	103.3333
35	99.8	107.2	103.2	101.7333	102.3333	101.6



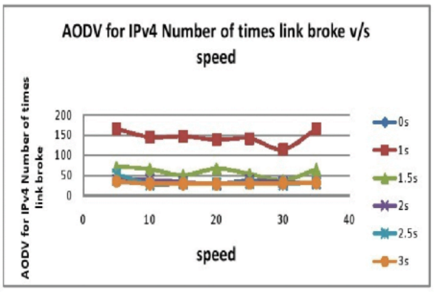
speed	0s	1s	1.5s	2s	2.5s	3s
5	0.649844	0.600669	0.615831	0.622297	0.628986	0.633222
10	0.671093	0.649721	0.666369	0.662687	0.657625	0.669119
15	0.684214	0.655295	0.678484	0.67068	0.649497	0.679333
20	0.679802	0.651728	0.671795	0.667469	0.668261	0.679376
25	0.695998	0.655518	0.667113	0.665106	0.663991	0.683835
30	0.659086	0.655518	0.649498	0.666667	0.674916	0.654404
35	0.676187	0.641472	0.664883	0.659755	0.657748	0.660201



speed	0s	1s	1.5s	2s	2.5s	3s
5	1.279131	1.381681	1.239405	1.2278	1.181943	1.117924
10	0.975371	1.098073	1.043502	1.023958	0.950222	0.998543
15	1.036291	1.086204	0.971272	1.006172	0.988085	0.978323
20	0.972261	1.099411	1.053672	0.904191	1.009538	0.924043
25	1.035935	1.081791	1.059299	1.047548	1.026312	0.989173
30	1.060571	1.086065	1.100713	1.016631	1.043498	1.037843
35	1.081419	1.209896	1.037673	1.087513	1.083001	1.007055



speed	0s	1s	1.5s	2s	2.5s	3s
5	2593.333	2470.333	2544.2	2566.6	2593.333	2556
10	2847.133	2689.067	2702.467	2718.333	2847.133	2739.333
15	2822.933	2706.533	2695.6	2708.867	2822.933	2747.8
20	2814.067	2693.4	2775.667	2727.867	2814.067	2791.533
25	2734.533	2714.067	2750	2745.867	2734.533	2742.6
30	2802.333	2710.867	2680.067	2711.667	2802.333	2728.467
35	2726.667	2652.4	2756.6	2725.467	2726.667	2713.8



speed	0s	1s	1.5s	2s	2.5s	3s
5	36.4	166.2833	71.33333	38.75	52.8	34.91667
10	28.61667	145.9167	65.61667	38.8	28.31667	29.13333
15	28.51667	147.6167	49.86667	33.8	29.48333	29.38333
20	28.21667	139.3	67.18333	28.75	29.51667	28.96667
25	29.7	142.1	53.21667	36.95	31.75	29.78333
30	28.95	115.1833	37.38333	32.75	28.08333	30.36667
35	30.86667	166.4333	65.15	30.9	32.78333	31.88333

Fig 13: comparison of hello interval with constant pause time

6. CONCLUSION

Any routing protocol gives excellent result if through put is high ,end to end delay is low ,jitter is also low, number of link break are low, packet loss is low & (PDR) packer delivery ratio is high, these are most important parameter to check out the performance or optimization. As per the simulation results, we have observed that in highly mobile habital use of hello message in particular interval helps us to get better PDR than without using hello message, in our paper we found if hello interval in 3 second with allow hello loss 2or 3 give better result than previous one mean compare to other hello intervals that thing shows by simulation results & graphs so this one can help us in future to better communication on real time situation fig 14 shows overall summary of simulation results.

To increase utilization of hello message, hello message interval should be up to the mark three second with hello loss between 2 & 3.

AODV Parameter	With hello message (HI=1 second)	With hello message (HI=1.5 second)	With hello message (HI=2 second)	With hello message (HI=2.5 second)	With hello message (HI=3 second)
Through put	LOW	LOW	LOW	LOW	HIGH
End to end delay	HIGH	HIGH	HIGH	HIGH	LOW
jitter	HIGH	HIGH	HIGH	HIGH	LOW
Packet loss	HIGH	HIGH	HIGH	HIGH	LOW
Number of link break	HIGH	HIGH	HIGH	HIGH	LOW
PDR	LOW	LOW	LOW	LOW	HIGH

Fig 14 Overall Summary of Simulation Result

7. REFERENCES

[1] A. E. Gamal, C. Nair, B. Prabhakar, E. Uysal-Biyikoglu, and S. Zahedi, “Energy-efficient scheduling of packet transmissions over wireless networks,” Proceedings of the Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM), vol. 3, New York, NY, June 23-27 2002, pp. 1773-1782.

[2] C. Bettstetter, “On the minimum node degree and connectivity of awireless multihop network,” Proceedings of the third ACM International Symposium on Mobile Ad Hoc Networking and Computing (MOBIHOC), Lausanne, Switzerland, June 9-11 2002

[3] C. E. Perkins and E. M. Royer. The Ad hoc On-Demand Distance Vector Protocol. In C. E. Perkins, editor, Ad hoc Networking, pages 173.219. Addison-Wesley, 2000.

[4] C. Srisathapornphat and C. –C. Shen, “Coordinated power conservation for ad hoc networks,” Proceedings of the IEEE International Conference on Communications (ICC), vol. 5, New York, NY, Apr 2002, pp. 3330-3335.

[5] Essam Natsheh, Adznan Jantan, Sabira Khatun, and Shamala Subramaniam,jully 2007,” Adaptive Optimizing of Hello Messages in Wireless Ad-Hoc Networks "

[6] Honolulu, Hawaii, October 2002)

[7] I. D. Chakeres and E. M. Belding-Royer. The Utility of Hello Messages for Determining Link Connectivity. In Proceedings of the 5th International Symposium on Wireless Personal Multimedia Communications (WPMC

[8] L. Buttyan and J. P. Hubaux, “Enforcing service availability in mobile ad hoc WANs,” Proceedings of the first ACM international symposium on Mobile and ad hoc networking & computing (MOBIHOC), Boston, Massachusetts, 2000, IEEE Press, pp. 87-96.

[9] M. Maleki, K. Dantu and M. Pedram, “Power-aware source routing protocol for mobile ad hoc networks,” Proceedings of the 2002 international symposium on Low power electronics and design, Monterey, California, USA, 2002, ACM Press, pp. 72-75.

[10] P. Divya1,s.hemlata ,2013” An Adaptive Hello Messaging and Multipath Route Maintenance in On-Demand MANET Routing Protocol”

[11] R.Gokila 2014,” An Efficient Secure Data Transmission for Adaptive Hello Messaging Scheme in Manet”

[12] Satish K Shah, “Development and Simulation of Artificial Neural Network based decision on parametric values for Performance Optimization of Reactive Routing Protocol for MANET using Qualnet” in Proceeding of International conference “Computational Intelligence And Communication Networks CICN 2010” as well as on IEEE website pp :167-171, 26-28 Nov 2010

[13] Shaily Mittal , Prabhjot Kaur,2009 “PERFORMANCE COMPARISION OF AODV, DSR and ZRP ROUTING PROTOCOLS IN MANET’S”

[14] Teresa Albero-Albero, Salvador Santonja-Climent, Víctor-M.Sempere- Payá, JordiMataix-Oltra,“AODV Performance Evaluation and Proposal of Parameters Modification for Multimedia Traffic on Wireless Ad hoc Networks