Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 79 (2016) 692 – 699

Procedia Computer Science

7th International Conference on Communication, Computing and Virtualization 2016

Improving QoS of Mobile Ad-hoc Network using Cache Update Scheme in Dynamic Source Routing Protocol

V. V. Mandhare[a], R. C.Thool[b]

[a,b]*S.G.G.S Institute of Engineering and Technology, Vishnupuri, Nanded- 431606,India*

Abstract:

The route caching plays significant role in on-demand routing protocol to improve the Quality of Service (QoS). QoS is very essential for various applications of MANET. Route discovery phase is used in on-demand protocol. To avoid route discovery scheme route caching strategy is used. Frequently use of route discovery is very cost effective solution in terms of QoS parameters. Hence, in this paper we have proposed new approach for cache updating using distributed route cache update algorithm. In conventional approach only the nodes involved in the routing path knows about the route error and those node only update their cache. But in U-DSR, by following distributed cache replacement algorithm, source node broadcasts the route error information of size 60 bytes to all its neighbours. Hence all neighbours replace the stale route in their cache. Experimental evaluation is done using network simulator (NS2) of monarch group. The proposed approach improves the performance up to 30%-40% using different QoS parameters like Packet Delivery Ratio (PDR), end to end delay, packet drop and energy consumption.

Peer-review under responsibility of the Organizing Committee of ICCCV 2016

*Keywords:*Mobile Ad-hoc Network, Dynamic Source Routing, Cache update, Quality of Service

1. Introduction

MANET is autonomous, decentralized, self-healing wireless network free to move from one place to another place [1]. There is a different type of application present which requires QoS of ad-hoc network. In such network routing plays key role to improve the performance of MANET applications. To achieve efficient routing various protocol in MANET is proposed in the literature [2]. When host moves, these routing algorithm are differ in the approach for searching a new path or modifying existing path [3]-[4]. The MANET routing protocol is generally categorized in to table driven, on-demand and hybrid routing protocol. The table driven routing protocol maintain up-to-date and

*Corresponding author, Email adress: v_mandhare@yahoo.com

Peer-review under responsibility of the Organizing Committee of ICCCV 2016
doi:10.1016/j.procs.2016.03.090

consistent information in ad-hoc network, on-demand protocol established the route when they require while hybrid routing use proactive and reactive approach to discover route.

Caching becomes essential in different real time applications. In on-demand protocol, route caching plays significant role. The frequent link breakage is present in ad-hoc network due to mobility which degrades the performance of network and ultimately QoS is reducing for various applications. The alternate route needs to search when route is broken. Again this ROUTE ERROR (RERR) message is propagated to all its neighbors only. If cached route is stale then packet drop may takes place and new route discovery is initiated. This new route discovery phase incurs heavy burden on network which result in delay to reach packet to destination, number of packet drop rate is high and energy consumption is high. Again transport layer may take mistake as congestion occurs on the path. If efficient caching mechanism is present then all drawbacks are removing in MANET and QoS is improved.

This paper presents the new cache update scheme using distributed route cache replacement algorithm. The link break is carried out then all neighbors update cache by removing stale route. In our approach Updated Dynamic Source Routing Protocol (UDSR), informs all the nodes involve in the topology about broken link information using RERR packet. In UDSR by following distributed cache update algorithm, source node broadcasts the RERR information of size 60 bytes to all its neighbors. Hence all neighbors replace the stale route in their cache. This scheme improves the overall performance of the network. Contribution of paper is that instead of informing RERR message to neighbors of broken link, information is propagated to all nodes involve in topology and stale route entries are also remove from route cache. This approach result in reduce delay and packet drop rate and improve packet delivery ratio and throuput.

The paper is organized as follow. Section 1 and 2, presents introduction and overview of Dynamic Source Routing (DSR) protocol. Section 3 presents the current literature review. Section 4 presents the cache update scheme to remove stale routes. Section 4 presents simulation environment used for Network Simulator (NS2). Section 5 demonstrate different QoS parameters like Packet Delivery Ratio (PDR), delay or latency, packet drop rate, throughput, energy consumption etc. Sections 6 demonstrate simulation results and discussion based on the proposed approach. Conclusion drawn based on the above experimentation is given in section 7.

2. Dynamic Source Routing (DSR) Protocol

2.1 Overview

DSR is simple, flexible, reactive routing protocol use the source routing instead of table driven approach. When packet wants to send to same destination DSR protocol uses multiple paths considering the loop freedom property. The main distinguish between this and other protocol is that it is beaconless and doesn't require periodic hello packet to inform its neighbor about it presence [6]. Two phases are present Route Discovery and Route Maintenance. Route is discovering in Route Discovery phase of DSR protocol. When source want to send the packet to its intended destination then firstly it check, weather the route is available in cache or not. If route is not present then new ROUTE REQUEST (RREQ) is initiated by source node. Packet reaches its intended destination by updating its cache. ROUTE REPLAY (REPLY) packet is send by destination containing packet information. The Route Maintenance phase is carried out using two processes. First hop by hop acknowledge is received to check weather packet is corrupt or lose. Second end to end acknowledgment is received from two host node. If no acknowledgment is received in time then ROUTE ERROR (RERR) message is sent to neighbored node about broken link information to update their cache [13].

2.2 Route Caching in DSR

DSR uses two caching path cache and link cache [5]. The path cache stores the information about each route to its intended destination. Link cache stores the information about how many links are available in graph. Thus link cache stores large information then path cache. Cache capacity and cache timeout are also two important things in cache management of DSR protocol. Cache capacity gives size of cache in DSR protocol while static and adaptive timeout mechanism is used in cache timeout mechanism to specify, how many time stale routes are present in the cache table.

When link is finding to be broken then this approach is very useful. The various approaches are proposed in the literature for timeout mechanism [7].

The reactive protocol initiates Route Discovery only when it is needed. The route cache is used by on-demand protocol, to reduce delay and routing overhead of initiating Route Discovery phase. The cache route becomes stale due to mobility. Un-necessary stale route degrades the performance of network, result in packet drop, delay, packet delivery ratio which affect the QoS of network.

3. Related Studies

To overcome the problems and improve the performance of network for cache updating scheme, various approaches are proposed and can be found in the literature [8-12].

R. Bhuvaneswari et al [8] proposed a new energy efficiency scheme for source routing (ESRS) algorithm to reduce the stale route cache problem. For route cache update scheme they develop five different mechanisms for cache update scheme. Simulation is carried out using NS2, shows better performance than conventional approach. S. Menaka et al. [9] proposed a new approach to update using preemptive link break prediction using Received Signal Strength Indicator (RSSI). Threshold is defined and link break is predicted using this value. The proposed approach improves the performance in terms of delay etc. Some modification in existing DSR is carried out by G. Narasa Reddy et al [10]. They add link break prediction algorithm to traditional DSR protocol for mobile node using signal power strength to notify that link is soon to be broken. Mahesh K. et al. [11] proposes negative route caches, timer based route discovery and wider error notification to reduce stale cache entries and to avoid cache pollution. Result shows 10%-&70 % improvement using proposed technique. The disadvantage of this technique is that freshness of routes is not considered. Link failure prediction QoS routing (LFPQR) protocol is proposed by D. Satya Narayana et al [12]. The mobility of node position and movement, power level determines the link breakage in this protocol. The protocols perform best compare to traditional AODV protocol.

Considering above facts, in this paper, we have proposed new approach using distributed route cache update algorithm. In this approach broken link information is propagated to all the nodes present in the topology and such entries are removing from the cache. Contribution of our approach is that conventional approach notifies to only neighboring nodes but using our approach link breakage (RERR) message is given to all nodes present in the topology. Removal of such stale routes increases performance of the network. Also latency and packet drop rate are reduced and PDF, throuput are increases using proposed approach. Thus QoS requirement are also meet for various applications.

4. Methodology

Fig. 1 present block diagram of proposed work. The traditional DSR protocol gives information, how cache update is carried out.

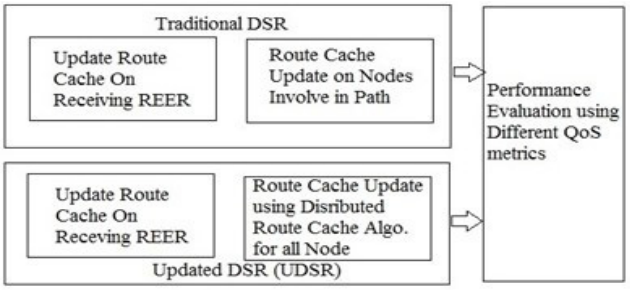


Fig.1: Block Diagram of Proposed System

When broken link information is detected RERR message is propagated and Route Cache is updated only the nodes involved in the routing path. New protocol UDSR updates the cache using distributed route cache update algorithm in distributed manner of 60 bytes for all the nodes present in the neighbours. The nodes involve in the path receives RERR message but the nodes not present in the routing path could not hears RERR message, hence using new

approach explicit RERR notification is made and send to all reachable nodes in the topology and update the Route Cache distributed manner. Such approach improves the QoS of network using different parameters. For route cache updates following algorithms are used.

Algorithm 1. AddRoute

Steps:

1. *Node adds a route from RPLY or from data packet.*
2. *If node is destination then it stores the source node and sets data packet (DP) to 0 as route is not used.*
3. *If it is not intermediate node then it check cache*
   - *3a. If route exist then cache table entry is carried out by DP to 0 creates Reply Record in which neighbour should learn downstream link.*
   - *3b. if route exist then it adds entry to Replay Record field.*
4. *If source route exist in cache then DP is 1.*
5. *If route doesn't exist then it is destination node and DP is 1.*
6. *If route doesn't exist then node is intermediate node and increments DP by 1.*
7. *If not having full path then it creates cache table entry and sets DP to 1.*

Algorithm 2: FindRoute

Steps:

1. *Cache is null.*
2. *For each entry path is store in cache table.*
3. *If node finds route then adds entry to Replay Record, including neighbours to which ROUTE REPLAY is send.*
4. *If node is source node and finds route then DP is incremented by 1.*
5. *If find route is sub route then add entry in cache table and DP is incremented by 1.*
6. *If data packet is salvage then not included in cache table.*

Cache update algorithm is work using above two algorithm in distributed manner and send REER notification of 60 bytes to all the nodes present in the topology.

5. Simulation Environment

Table 1 illustrates simulation environment use for route cache update. Original DSR protocol is modified and new protocol U-DSR protocol is designed by modifying dsr.cc and dsr.h files according to the proposed method and ns2 is rebuilt with newly added protocol with the files u_dsr.h, u_dsr.cc, u_dsr_packet.h, u_dsr_rtable.cc, u_dsr_rtable.h, u_dsr_rqueue.cc, u_dsr_rqueue.h, and u_dsr_logs.cc.

Table 1: Simulation Environment

Parameters	Values
Area	500m x 500m
No. of Node	10,20,30,40,0,60,70,80,90,100
Pause Time	3,6,9,12,15
Mac Type	802.11
Interface Type	Phy/WirelessPhy
Queue Length	50 Packets
Antenna Type	Omni Antenna
Propagation Type	TwoRayGround
Mobility Model	Random Way Point
Application Agent	CBR
Transport Agent	UDP
Routing Protocol	UDSR
Simulation Time	50seconds

6. Simulation Parameters

New approach is measured using different QoS parameters as mention below.

6.1 Packet Delivery Ratio (PDR)

PDR is the amount of packet successfully reached to the destination.

$$PDF=\frac{P_{nr}}{P_{ns}} \quad (1)$$

Where, P_{nr} =Number of Packets Received, P_{ns} =Number of Packets Send

6.2 End –To-End Delay

It is the ratio of time difference between numbers of packet send and received over the total time require to reach the destination. If delay reduces then performance of network gives better output.

$$D_y = \frac{1}{N}\sum_{i=1}^{J}[PR_J - PS_J] \quad (2)$$

Where, D_y = Delay, PR_J = Number of packet received at ^{jth} time. PS_J = Number of packet send at ^{jth} time, N = Number of node.

6.3 Overhead

Number of routing packets generated in the network is routing overhead. If routing overhead is high then performance of protocol is reduce which affect the QoS in MANET.

6.4 Packet Drop

It is the number of packets not received in the destination is the packet drop rate.

$$D_p = S_p - R_p \quad (3)$$

Where, D_p = Dropped packets, S_p = Number of Send Packets, R_p = Number of Received Packets

6.5 Energy Consumption

It is the average energy consumed by each node. When numbers of control message flooded are high then more energy is consumed by each node.

$$AEC = \sum_{i=1}^{n}\frac{(E_c)_i}{N} \quad (4)$$

AEC = Average Energy Consumption, E_c = Energy consumed by each node, N = Number of node.

7. Result and Discussion

Above mentioned QoS parameters are consider for evaluating the performance of new approach for updating the cache.

7.1 PDR

Fig.2 demonstrates PDR with respect to pause time and number of node. PDR of UDSR increases as compare to conventional DSR protocol because all nodes know about broken link information using our approach, RERR

notification is send to all the nodes and node update their cache. Thus, packet drop rate is reducing which effect on PDR of proposed protocol which is shown in Fig. (a). When pause time increases PDR goes on decreasing. For other condition when number of nodes considers UDSR increases up to 8%-36%. When network size increases, lots of packets may drop which result in low PDR which is demonstrated in Fig. (b).

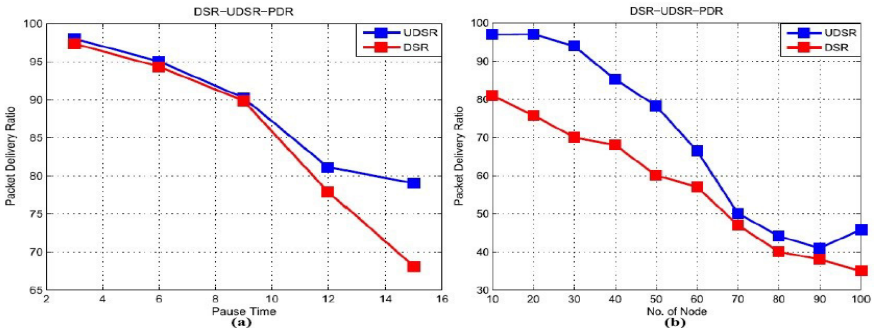


Fig.2 (a) PDR vs. Pause Time (b) PDR vs. No. of Node

7.2 End –To-End Delay

Fig.3 (a) End-to-End Delay vs. Pause Time (b) End-to-End Delay vs. No. Of Nodes

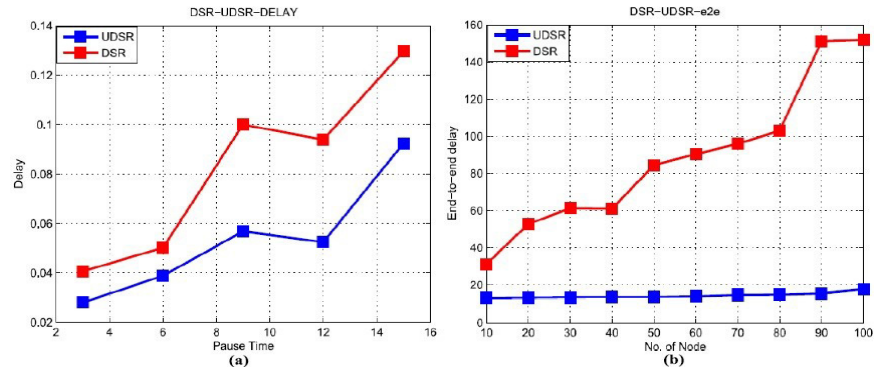


Fig. 3 depicts the delay occurs to reach the packet to destination. Using conventional approach delay is high because of route cache present and to look at cache every time, weather route is present or not. This main drawback is reducing using our approach in UDSR protocol. Delay is reduce from 15% - 50% as shown in (a) and (b). When pause time increases delay is also increases because more number of nodes is present for communication.

7.3 Overhead

The routing overhead considers for pause time and number of node is presented in Fig. 4. As compare to other routing protocol DSR has low overhead because of route cache present. Instead of initiating new RREQ every time, it sees in to cache. Our new approach reduces the overhead using REER notification to nodes present in topology. When pause time increases as get steady performance, but when network size increases, routing overhead also increases as number of nodes increases. One more reason is that stale route entries are remove from the cache which reduce the overhead and improve QoS of network.

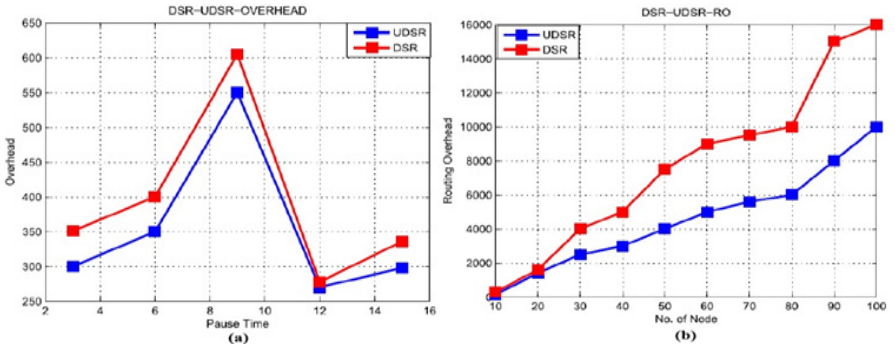


Fig.4 (a) overhead vs. Pause Time (b) Overhead vs. No. of Node

7.4 Packet Drop

Fig. 5 depicts the packet drop rate of proposed approach using mentioned two conditions. When we compare both graph (a) and (b) using new approach packet loss is reduce up to 10%- 23% using pause time . The network size increases it reduce from 3% - 18 %. The cache updating is carried out using our new approach; hence packet drop is reduced as shown in Fig 5 (a, b).

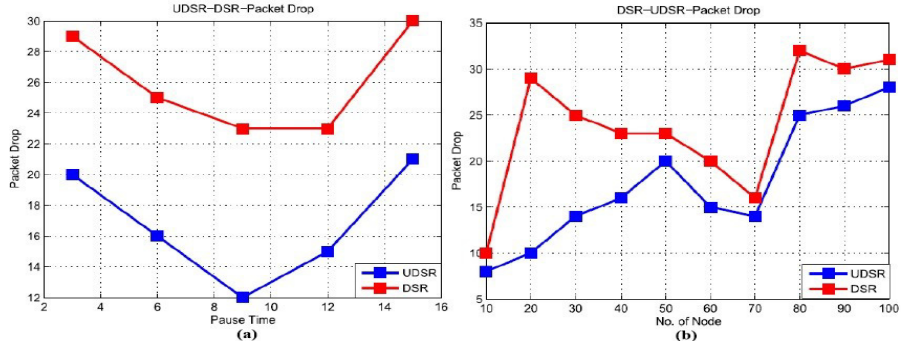
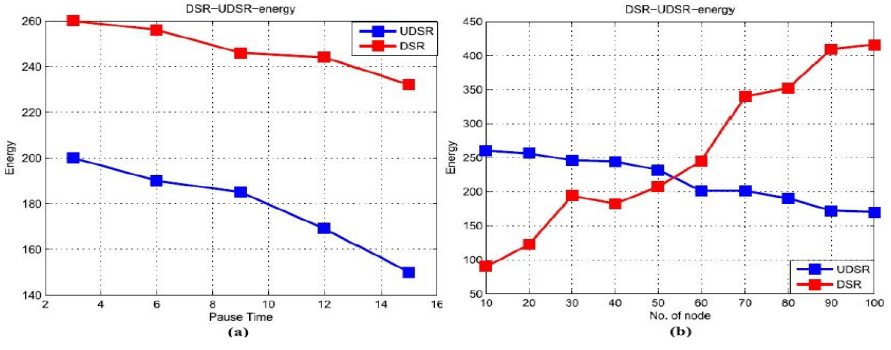


Fig.5 (a) Packet Drop vs. Pause Time (b) Packet Drop vs. No. of Node

7.5 Energy Consumption

Fig. 6 represents energy consumption with respect to pause time and number of node. The DSR protocol requires high energy as compare to other routing protocol because of cache problem. This problem tries to reduce using proposed approach.



.

Fig.6 (a) Energy Consumption vs. Pause Time (b) Energy Consumption vs. No. of Node

When we consider pause time 34% improvement is done. When network size increases UDSR outperforms low due to congestion occurs in the network

6. Conclusion

For adaptation of on-demand protocol, cache updating play key role. This paper present the route cache update algorithm in distributed manner using explicit RERR notification message to all nodes of 60 bytes. Different QoS parameters are consider for evaluation using NS2. This new approach improves the performance of DSR protocol up to 30%. The main challenge in routing protocol is how effectively they handle when topology is change. Proactive protocol handles topology changes but result in more overhead while, reactive routing protocol is face the problem of route cache still such protocols are good solution for various application. Hence our approach is helpful to improve the network performance using different parameters. In future try to enhance distributed cache update algorithm very robustly to improve QoS to network.

References

1. C. Siva Ram Murthy and B.S. Manoj, "*Ad-hoc Wireless Network- Architecture and Protocol*" Prentice Hall communication Engineering and Technology, pp. 205-213, 2004.
2. A.A.A. Radwan, T.M. Mahmoud, E.H. Houssein. Evaluation comparison of some ad hoc networks routing protocols. *Egyptian Informatics Journal, Elsevier*, 95–106, (2011)12.
3. DuyenTrung H, Benjapolakul W, Minh Duc P. Performance evaluation and comparison of different ad hoc routing protocols. *Elsevier ComputCommun*30:2478–96, 2007.
4. Ahvar E, Fathy M. Performance evaluation of routing protocols for high density ad hoc networks based on energy consumption by GloMoSim simulator. *World AcadSciEngTechnol*; 2007.
5. Y.-C. Hu and D. Johnson. Caching Strategies in On-Demand Routing Protocols for Wireless Ad Hoc Networks. Proc. Sixth *ACM MobiCom*, pp. 231-242, 2000.
6. J. Broch, D. Maltz, D. Johnson, Y.-C. Hu and J. Jetcheva. A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols. Proc. *Fourth ACM MobiCom*, pp. 85-97, 1998.
7. V. V. Mandhare, R. C. Thool. Improving Performance In Mobile Ad-hoc Network Using Data Caching Schemes: A Review, *International Journal of Computer Technology & Applications*,Vol 5 (5),1780-1788, 2014.
8. Bhubaneswar, R. and M. Viswanathan. Efficient Source Routing Scheme for Mobile Ad hoc.Networks, *International Journal of Computer Applications, 48(17)* 2012.
9. S. Menaka and M.K. Jayanthi. Effective Stale Routes Management Using Preemptive Routing in DSR. *World Applied Sciences Journal 22 (11):* 1554-1560, 2013 ISSN 1818-4952.
10. Narasa Reddy, G., A. Avanthi and R. Prasanth Reddy. Enhancing DSR Protocol Performance in Mobile Ad Hoc Networks using Proactive Route Maintenance (PRM). *International Journal of Advanced Research in Computer Science and Software Engineering*, 2(5): 366-371, 2012.
11. Mahesh K. Marina and Samir R. Das, Performance of Route Caching Strategies in Dynamic Source Routing, Department of Electrical& Computer Engineering and Computer Science, University of Cincinnati.
12. D. Satyanarayana, S.V. Rao. Link Failure Prediction Qos Routing ProtocolFor Manet, *IET-UK International Conference on Information and Communication Technology in Electrical Sciences (ICTES 2007) IEEE*, Dr. M.G.R. University, Chennai, Tamil Nadu, India. Dec. 20-22,. pp.1031-1036, 2007.
13. V. V. Mandhare, R. C. Thool. Comparing the Performance of Proactive and Reactive Routing Protocol in Mobile Ad-Hoc Network, *International Conference on Industrial Instrumentation and Control (ICIC-2015) IEEE*, pp 394-399.