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Effective Retransmission Reducing Ad hoc On Demand Multipath Distance Vector Routing Protocol for VANET

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Abstract— The eminent efficiency protocol is always mandatory for data routing in the network. The protocol's efficiency to deliver the data reduces due to path loss and leads to retransmission. In available protocols, Ad hoc On-Demand Multipath Distance Vector (AOMDV) which routes the data from source to destination node via multiple paths, however unable to avoid the retransmissions and Secure Ring Broadcast (SRB) routing protocol stabilizes the routes established but cannot neutralize the retransmissions. Due to path loss these retransmissions introduces time delay in data transfer and increases with traffic. But, no efficient protocols are available to neutralize retransmissions. The Effective Retransmission Reducing Ad hoc On-Demand Multipath Distance Vector (ERRAOMDV) routing protocol is proposed to avoid the retransmissions when path loss by making handoff. The retransmission reduces to negligible value as compared to any available protocols as shown in the analytical and simulation results.

Keywords— Effective Retransmission Reducing Ad hoc On-Demand Multipath Distance Vector (ERRAOMDV), VANET (Vehicular Ad Hoc Network), Ad Hoc on Demand Distance Vector (AODV), Ad hoc On-Demand Multipath Distance Vector (AOMDV), Mobile Ad hoc Network (MANET).

INTRODUCTION

The VANET is the network comprised of randomly moving nodes with variable speeds and static road side units [1]. Due to uncertainty of data traffic, movement direction, random location and number of nodes, the VANET is highly dynamic in nature. The communication in the VANET is direct from node to node, unlike Mobile Ad Hoc Network (MANET). In the VANET, a node dissociates from the route randomly and leads to path breakage [2]. Therefore, the potent routing protocol implication is significant.

The parameter name 'connection lifetime' is the time period for which path between the source node to destination node exists without retransmissions. Accordingly, the 'connection lifetime' must be longer for sophisticated implications like video conferencing and inter-vehicle voice communications in VANET. Therefore, the consistent and faster data transfer needs longer 'connection lifetime' for such sophisticated implications. The retransmission is inversely proportional to the 'connection lifetime' parameter. If the 'connection lifetime' is less then retransmission will be more. Hence, the 'connection lifetime' will increase by neutralizing the retransmissions. The retransmission process includes re-initiating the search and the establishment of the route between source and destination node. This retransmission process increases the latency by introducing huge time delay. Consequently, retransmissions slow down the data transfer from source to destination node. The retransmission increases with the increase in data traffic and the number of nodes. In the urban traffic scenario the data traffic and number of nodes are very arbitrary. At any instance of time the number of nodes and the data traffic may increase exponentially in the urban traffic scenario. This makes urban traffic scenario highly random in comparison with the highway traffic scenario. Therefore, the occurrence of retransmissions is high in the urban traffic scenario. Consequently, the urban traffic scenario requires a potent protocol to neutralize the retransmissions by making the handoff while the path loss. The handoff compensates broken path and avoids the retransmissions to occur. Handoff is the process in which the data routing is transferred from the node leaving the route to the node retaining or coming in route. The handoff process avoids the call drop in the MANET and can be used in VANET to avoid retransmissions. But, the achievement of handoff operation in the VANET is a difficult assignment compared to MANET. The MANET architecture manages the handoff process which is absent in VANET. The MANET architecture consists the network of cell towers and MTSO. A highly efficient protocol is required to make handoff and avoid retransmissions without architectural support in VANET.

The criterion to recognize route loss, intermediate node selection and shifting data route at available node is required in a protocol to realize the handoff process in VANET. But, the criterion to recognize the path loss and shift the data route from current node to available node is absent in protocols available. Due to the absence of criterion for intermediate node selection and to shift data route at selected node the handoff could not be possible and retransmission occurs. This article presents a new protocol idea to neutralize the retransmissions unlike any protocol available. If the route breaks at any instance between source to destination node then retransmission occurs. The proposed protocol recognizes the route loss circumstance, selects available node and shifts the data route to the selected node. Unlike MANET, this protocol implicates the handoff process successfully in VANET without architectural support. Accordingly, the 'connection lifetime' is increased and retransmissions are neutralized by the proposed protocol. The proposed protocol rectifies the demerit of existing protocols and boosts the operation of data routing from source node to the destination node.

LITERATURE REVIEW

Various protocols implicated for routing data in VANET are Fisheye State Routing (FSR), Ad hoc On-Demand Multipath Distance Vector (AODV), Secure Ring Broadcast (SRB), Zone Routing Protocol (ZRP), AOMDV and Directed Route Node Selection (DRNS) etc. These protocols have deteriorated performance with traffic increase. The single or multiple routes may exist between the source node and the destination node. The proposed proactive approach of fast-handoff making algorithm has utilized Access Point (AP) in VANET to reduce the hand-off' latency. The Fast Hand-off making algorithm utilized AP graph to improve the re-involvement latency and separate context transfer [3]. The authors utilized the idea of cluster and hands-off for better performance. The performance of Traffic Infrastructure Based Cluster Routing Protocol with Handoff (TIBCRPH) is found better than some available routing protocols [4].

The authors described the solution of the spectrum handoff problem by cross-layer optimization approach with estimation of routing and spectrum handoff planning. The Joint Spectrum Handoff Scheduling and Routing Protocol (JSHRP) minimized the spectrum handoff latency for the circumscription of network connectivity by coordinating multiple links spectrum handoff. The proposed protocol minimized multiple links spectrum handoff latency totally in a cognitive network [5]. A proposed novel algorithm monitored signal quality at user end by Modulation Error Rate (MER) evaluation and approximation [6]. An adaptive multipath protocol is proposed to accomplish less hand-off latency for hard handoff [7].

METHODOLOGY

Many protocols have been developed to reduce the retransmissions in VANET. But all these protocols discussed above have non-satisfactory performance. Only one path from the source node to destination node by all these protocols are possible same as AODV. But this single path from the source to destination node is not enough for the large data transfer. Therefore, a path adaptive routing protocol is required to neutralize the retransmissions and lower the latency.

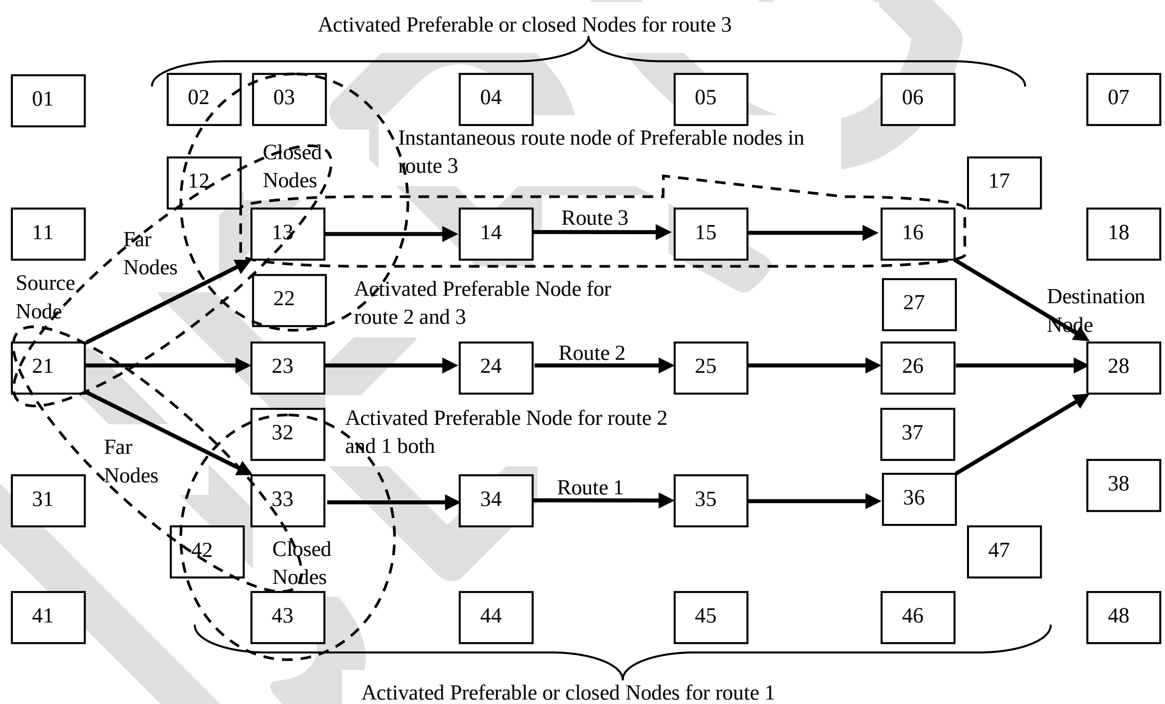

Fig. 1. Routine operation of ERRAOMDV routing protocol.

The operational features of proposed protocol are following:

1. Initially, the data is routed just like AOMDV.
2. Neutralize the retransmission when the route loss.
3. For neutralizing the retransmission, select the node from preferable nodes.
4. Without retransmission route the data via selected node.
5. Search closest intermediate node to another end node and avoid retransmission, in the absence of preferable nodes.
6. Complete the data transfer without retransmission from source to destination node, when another end node found. Hence, it avoids the time delay due to retransmissions in the network transfers data faster.

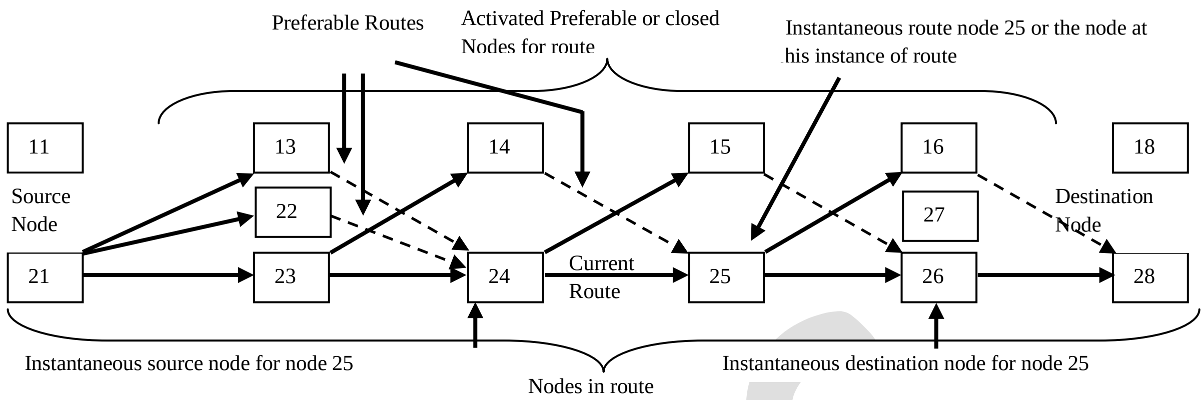

Fig. 2. Activation of preferable nodes by ERRAOMDV routing protocol.

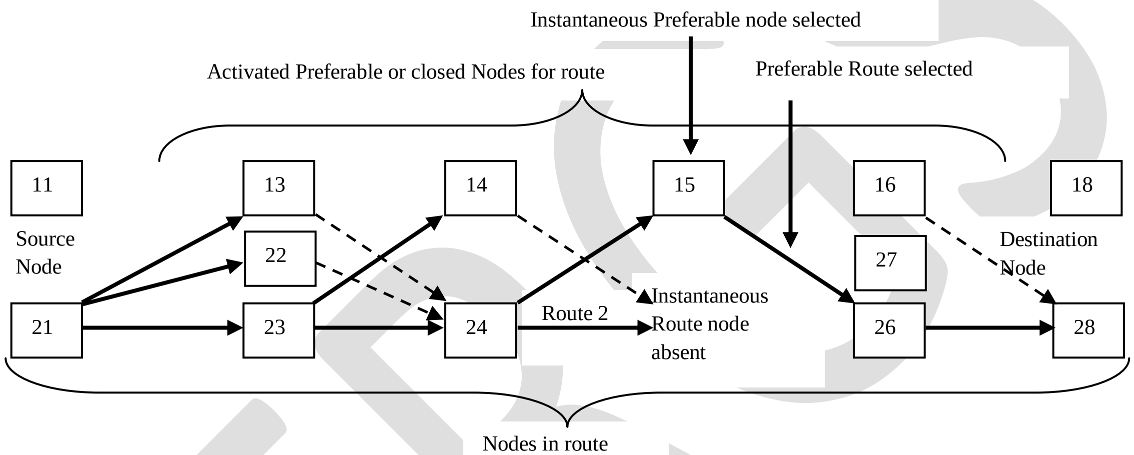

Fig. 3. Selection of instantaneous preferable node to neutralize retransmission by ERRAOMDV routing protocol.

The multipath data routing is shown in the Fig. 1. The route 1, route 2 and route 3 include nodes {21, 13, 14, 15, 16 and 28 respectively}, {21, 23, 24, 25, 26 and 28 respectively} and {21, 33, 34, 35, 36 and 28 severally. The instance is time instant for which the route node at the specific location. The node at any instance of location on route is an instantaneous route node.

Therefore, these nodes in the route are referred as instantaneous nodes in the route. The preferable nodes associated with an instantaneous route node are referred as instantaneous preferable nodes. As shown in the Fig. 1. nodes {02, 03, 12}, {04}, {05}, {06, 17} are instantaneous preferable nodes for the instantaneous root node 13, 14, 15, 16 on route 1. Similarly, nodes {22, 32}, {27}, {37} and nodes {32, 42, 43}, {33}, {34}, {35}, {36, 47} are instantaneous preferable nodes for the instantaneous route node 23, 24, 25, 26 in route 2 and node 33, 34, 35, 36 on route 3. The preferable nodes are only preselected intermediate neighbor nodes which neutralizes the retransmission by making the handoff. The preferable nodes are not used to route the data till the path loss due to absence of instantaneous route node or the route node at any instance for data routing. If the instantaneous route node or the route node at any instance of location is absent for data routing then preferable nodes in that instance or the instantaneous preferable node will be selected.

These preferable nodes are closed neighbor nodes (exposed nodes) for the instantaneous nodes in the route. The destination node and source node of that instantaneous route node is referred as instantaneous source node and instantaneous destination node as shown in the Fig. 2. The preferable nodes are exposed nodes to the instantaneous source node, instantaneous destination node and instantaneous nodes in the route. Accordingly, every instantaneous preferable node observes the echo of same data three times from the instantaneous source node, instantaneous node in the route and instantaneous destination node in the route. Consequently, the echo of the same data at second time is always from the instantaneous node in the route.

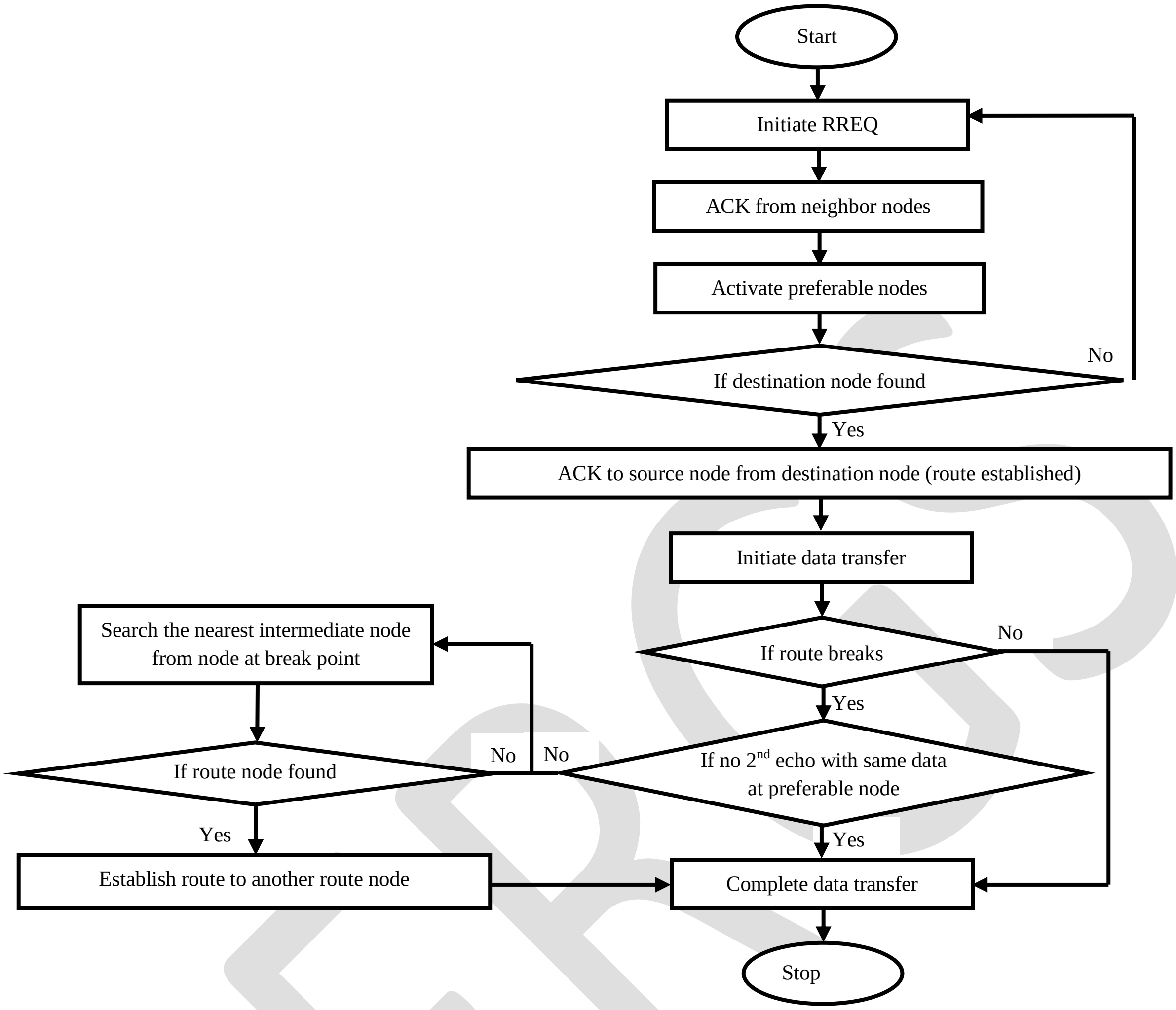

Fig. 4. Flow graph of the ERRAOMDV routing protocol.

As shown in the Fig. 3. when the node 15 echoes the data to node 26 then the handoff from node 25 to node 15 is acknowledged at instantaneous source node 24 and instantaneous destination node 26 both. The flow graph of the ERRAOMDV protocol is illustrated in above Fig. 4. The algorithm of the proposed ERRAOMDV protocol is following:

1. Send RREQ to each neighbor nodes for route searching to the destination node.
2. Generate the ACK to the source node and select the preferable nodes.
3. Transfer the data from source node to the destination node.
4. Activate the instantaneous preferable node to accomplish complete data transfer to the destination node, if "echo < 2".
5. If no instantaneous preferable node found, then initiate the RREQ form the node at path breakage to find a node in route at the other end.
6. If another end node found, then complete data transfer.
7. The preferable node is out of range or route does not exist or data transfer completed, if "1 > echo" or "no echo".

ANALYSIS

The probability of retransmissions and latency is derived from analysis of ERRAOMDV and existing protocols. For analysis the distance between source and destination node (Ds) is considered constant. The retransmissions probability (R) the mathematical analysis of is given below:

$$R \propto 1/P$$

$$R = c_r / P \qquad (1)$$

Here, c_r is the constant of proportionality. The c_r for AOMDV and AODV is given below.

$$c_r = ({}^{P}C_{P0}\, p^{P0}\, q^{(P-P0)})n_e \qquad (2)$$

The c_r for ARNAOMDV is given below.

$$c_r = ({}^{P}C_{P0}\, p^{P0}\, q^{(P-P0)})/n_e \quad (3)$$

Here, cr is acquired by applying Bernoulli's equation and C is combination of P0 paths out of P paths in Bernoulli's equation of probability. The p and q are probabilities of establishing path and losing path. The P is the total number of paths possible, P0 is the accomplished number of paths and ne is the number of nodes engaged. The latency T is the given below:

$$T = D_s\, tD_d\, c_r /P \quad (4)$$

Here, T is latency, D_d is data size and t is required node to node time of a single hop.

ACKNOWLEDGMENT

The simulation result of the proposed protocol using NS2 is shown in Fig. 5 (a).

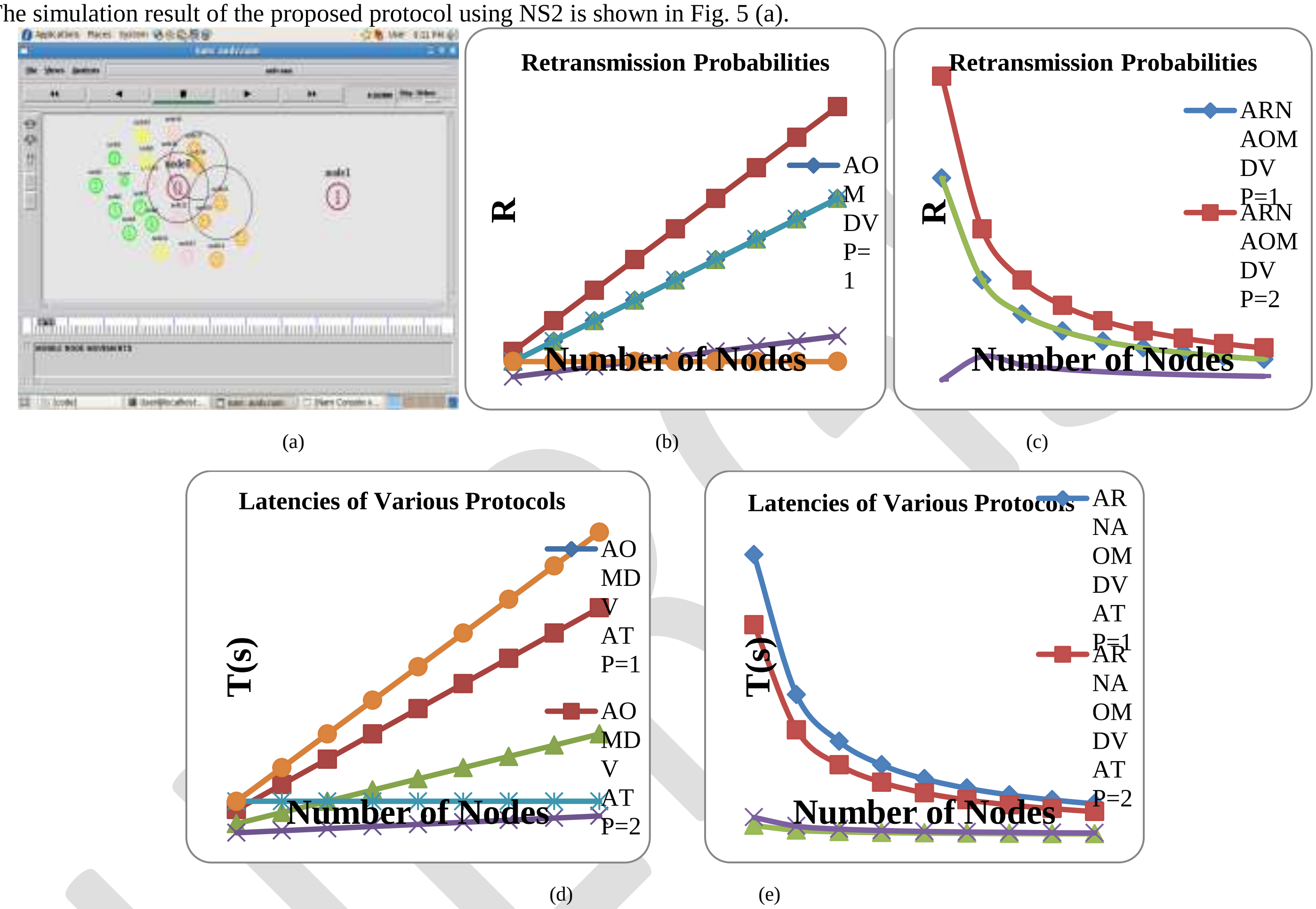

Fig. 5. Analytical results of protocols. (a) Simulation result of ERRAOMDV. (b) R of various protocols. (c) R of ERRAOMDV protocol. (d) Latencies of different protocols. (e) Latencies of ERRAOMDV protocol for different number of paths.

The analytical results of the proposed protocol with other protocols using MATLAB are shown in Fig. 5. The retransmission constants and latencies of various protocols have been illustrated in Fig. 6. As illustrated in Fig. 6 (a) and (b) the latency of the ERRAOMDV decreases unlike other protocols with an increase in the number of nodes. The ERRAOMDV protocol latency is low as compared to existing protocols. In the Fig. 6 (c) and (d) the retransmissions for the AODV, SRB, AOMDV and ERRAOMDV are shown. The retransmission constants of the ERRAOMDV are also low as compared to other protocols.

CONCLUSION

The operation of the ERRAOMDV protocol has been explained in this paper. This proposed protocol successfully neutralizes the retransmissions to occur because of route loss by using a handoff process. Therefore, this protocol increases the throughput with the reliable data delivery and reduces the latency, retransmissions. This protocol contains the advantages over the existing protocol to neutralize the retransmission at path loss but not their disadvantages. Unlike other protocols, it does not require the cluster formation and much information of the neighbor nodes to make handoff and neutralize the retransmissions. Unlike other protocols, it is more reliable, faster and performance efficient protocol.

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