International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Optimal Backpressure Data Transmission Using Deep Learning

Aarthi S[1], Dr. S. Jothi Lakshmi[2]

[1]PG Schloar, Department of CSE, Akshaya College of Engineering and Technology, Kinathukadavu, Coimbatore, TamilNadu, India

[2]Associate Professor, Department of CSE, Akshaya College of Engineering and Technology, Kinathukadavu, Coimbatore, TamilNadu, India

Article Info

Publication Issue :

Volume 8, Issue 4
July-August-2022

Page Number : 349-358

Article History
Accepted: 10 August 2022
Published: 30 August 2022

ABSTRACT

In Mobile Ad Hoc Networks (MANETs) Wireless devices are designed to work in co-operative manner. These devices are connected via wireless link to communicate with each other. The MANET has emerged as an important aspect in the wireless domain. This feature is due to the due to its simplicity and self-reconfigurable. In such networks, each mobile node is not only acting as a host but also act as a router which performs the packet forwarding process to other mobile nodes in the network. It is occurred due to the lack of precise congestion indication and hidden terminal problems. In order to handle the congestion issues, the explicit notification is generated as the process of backpressure transmission. The solution must have capability to handle bad channel condition and connectivity failures in unicast transmission. Joint congestion control scheme with scheduling algorithm is improved for dynamic wireless network by changing scheduling scheme with adaptation model. Our end-to-end delay and throughput bounds are in simple and closed forms, and they explicitly quantify the trade-off between throughput and delay of every flow. Furthermore, the per-flow end-to-end delay bound increases linearly with the number of hops that the flow passes through, which is order-optimal with respect to the number of hops. In the proposed system, the optimal congestion control and flow control model is being developed using the deep belief network in deep learning.

Keywords— Deep Learning, EWMA, Wireless Networks, BackPressure and Congestion Control.

I. INTRODUCTION

The In a wireless network, the nodes or devices communicate with each other by using radio waves or electromagnetic waves. Whenever a device wants to communicate with other devices, the corresponding devices must be present within its radio range. The wireless network is widely preferred due to its simplicity, compactness, mobility, and cost effectiveness. The centralized network directly creates and maintains the communication between mobile hosts and Base Station (BS). This network is a dependent communication model. The communication is established between mobile hosts without using any centralized infrastructure model. It is an independent communication model.

Ad Hoc network is a set of independent devices which can communicate with each other without any fixed infrastructure is shown in Figure 1.2. In this type of network, any node can join or leave freely in a distributed manner. A node can act as a router node to forward the data to the neighbor nodes, which in turn transfer the data to the destination node. Any node can become router node to accomplish the data forwarding process, hence this network is known as infrastructure-less networks. This network does not have any centralized device to operate or to control the other devices. Due to the topological changes, the link unavailability and device unavailability causes the broken connectivity between the mobile devices. Ad-hoc devices automatically handle this link failure problem by applying re-configuration capability of the devices.

Wireless networks are most commonly used access services on the Internet. But this has lower performance when compared to wired networks. Losses in wired networks are mainly due to congestion in routers. This is because congestion is usually handled by dropping the received packets when the router waiting queues are full or nearly full. Losses in wired networks considered as an indication of congestion. In wireless networks, losses often occur for various reasons, due to interference or poor link quality (that is high distance between the base station and the mobile device).

IEEE 802.11 already includes mechanisms to combat losses at the MAC layer. Wireless devices retransmit lost packets on a wireless link a certain number of times (6 for example). However, in case of long interferences, a packet can be lost 7 times consecutively on a wireless link. In this case, the device drops it and the transport level of the source discovers the loss.

A smaller step size is to ensure that the joint congestion control and scheduling algorithm to linkup the close-to-optimal system throughput. One can use the step sizes to tune the throughput–delay trade-off. This means a change of the step size on one node will affect all flows passing through the node. Therefore, it is difficult to tune the throughput–delay trade-off on a per-flow basis. In this paper, we will implement the joint congestion control and scheduling algorithms that achieves both provable throughput and per-flow delay. However, the key difficulty in analyzing the end-to-end throughput and delay under this algorithm is that the services at different links are correlated. As a result, a Markov chain analysis will not provide a closed-form solution.

There are approaches that are available to solve congestion control and scheduling problem and most of these approaches do not consider delay performance. A typical optimal solution can be obtained by a duality approach that results into the back-pressure algorithm and a congestion-control component at the source node. Furthermore, a considerable amount of effort has focused on developing low-complexity and distributed scheduling algorithms that can replace the centralized back-pressure algorithm and yet still achieve provably good throughput performance. These low-complexity scheduling algorithms are usually also queue-length-based as like back-pressure algorithm. The drawback of these approaches, however, is that the end-to-end delay of the resulting queue-length-based scheduling algorithm is very difficult to quantify under certain cases the back-pressure algorithm can have poor delay performance.

II. RELATED WORK

The discovery of multiple loop free paths is performed by including the path deciding factor, hop count, and trust values. The device behaviors are observed and the flexible path to connect the source and destination. This evaluation is performed by Saedi et al (2021) to mitigate the black hole gray hole and modification attacks. The available channel based link layer switching and routing model was developed to provide the multi interface communication in MANET. The fixed and switchable interfaces are used by the link layer protocol to decrease the link failure probability along with the switching cost. The link failure probability of the path is determined from the link failure probability values of the individual link. This estimation is performed during the transmission of the route discovery messages, including the route request, route reply, and route error messages.

It examined the routing problem in 3D network and provided a solution using a meta heuristic algorithm. Tabu Search (TS) and guided local search were applied to solve the routing problem. TS process was executed in a periodical manner to increase the effectiveness of the search process. The different packing structure is designed to increase the probability of obtaining feasible loadings. The mechanism of broadcasting and clustering approach is combined to form the routing structure as proposed for MANET. In this approach, instead of unicasting the route reply message, it is broadcasted via the nodes present in the cluster to form the topology tree which is used to transmit the data over the wireless medium

QOS IN TRANSMISSION

The cross layer optimization framework is designed by Khan et al (2021), for multicast communication in multihop wireless mesh networks. Throughput maximization and wireless contention are the main factors considered to decompose the optimization problem with the set of Lagrangian variables. This framework solves the power control and data routing problem by using the network coding. The interference management is applied by using the game theory process. QoS supported routing protocols in MANET is evaluated and the comprehensive survey is provided. This work mainly points out the issues in QoS aware routing and also provides the solution to handle problems such as land balancing, bandwidth utilization, and traffic management.

A set of table driven routing protocols, including Ticket based routing, Optimized link state routing and Adaptive QoS Routing protocols, and On-demand routing protocols such as Core Extraction Distributed Ad-hoc Routing protocol, Ad –hoc QoS on-demand routing in the MANET and Adaptive QoS routing protocols were evaluated in this survey. They concluded that it is the efficient method to handle the QoS aware routing, which estimates the bandwidth required for the communication and evaluates the protocol performance in terms of delay, delivery ratio, and throughput. In order to find the feasible path satisfying the multi objective constraints in MANET provided the solution based on the heuristic model. The algorithm converts the energy function as multiple weights to seek the feasible path using the polynomial and pseudo-polynomial time complexities. A simulated annealing algorithm was used to select the optimized path to connect source and destination.

CONGESTION CONTROL

Malarvizhi et al (2021) proposed the polymorphic routing protocol, which hybrids the proactive and reactive multicasting process. Transmission request and limited network traffic overhead were derived from the proactive transmission. Power, mobility, and vicinity density of the neighbor nodes were extracted from the reactive parameter of the transmission. The transmission adaptation and multi behavioral modes of operation were augmented using the optimization scheme. Fast restoration for link disconnection and node failures was introduced by performing the local bypass activation. The restoration capacity was minimized and shared during the restoration of bandwidth guaranteed connections. The combinational algorithm was developed with the approximation of fully polynomial time, which guarantees the closeness to the optimal solution. Node failures were handled by routing with restoration, which computed the minimized cost structure by applying phase with respect to scaling factor.

The communication pattern was identified from the estimated throughput based on the current wireless topology. It mainly considered the tradeoff between the transmission flows among the wireless routers. It avoided the wireless interference by utilizing the link which maximizes the network throughput. The route selection was based on the network coding, which performs the broadcast scheduling. Li et al (2021) provided a novel solution for multicast communication in Multi Radio Multi channel model. The multicast communication problem is formulated by the Integer Linear Programming (ILP) by using the polynomial time algorithm. ILP minimizes the interference list by integrating the wireless closet terminal branching. The multicast session allocates the interfering between the multicast trees by employing the minimization of co-channel interference. Real time packet transmission over the wireless medium was developed. The packet rate adaptation was applied by means of transcoding and packet dropping to investigate user perceived video quality. In order to minimize the quality degradation of video transmission, the most suitable rate adaptation was determined by verifying the presence of constrained resources of the wireless devices.

ROUTE FAILURE HANDLING

The local failure of the route and path reestablishment during path unavailability as well as packet collision and bad channel condition was proposed as fast route recovery which is done by Zhang et al (2021). This approach reduces the control overheads as well as increases the packet transmission reliability by applying the backup node's reliability in MANET. To avoid the misjudgment of mobility, backup node's acknowledgement was employed. The performance enhancement of the MANET based on the directional communication employs the dual polarization method. In this approach, orthogonal polarization of the directional antenna communication model was utilized to improve the node capacity as well as network performance. Also recommended that dual polarized directional communication to amend the quality of the communication. A novel approach was applied to estimate the available bandwidth based on the Lagrange interpolation polynomial computation implied.

This interpolation estimation was applied dynamically to each node by means of the workload of the node and channel utilization during the optimal workload and collusion rate. The collusion probability model is irrespective of the node behavior. This method is mainly proposed for the high dynamic mobility devices. The krill herd is bio-inspired optimization for the power efficient routing scheme which is processed by the local and global optimization. This krill herd method supports high mobility with the local optimization. This krill herd is mainly supported for the dynamic changes in the network topology. During the packet reception of broadcasted packet, each receiver node estimates the binary code to transmit the data as well as to start transmission or to listen the sequence. At the end of communication any node detects a signal then it quits the selection process. This model is based on CDMA communication methodology which spreads the orthogonal codes in all possible directions.

OPTIMIZATION IN BACKPRESSURE NETWORK

Wireless Mobile devices are designed to work in a cooperative manner in data transmission. These devices are connected via wireless link to communicate with each other. But this fails in several transmission reasons, such as node mobility, channel collision, and abnormal channel conditions. The solution must have the capability to handle poor channel conditions and connectivity failures in both unicast and multicast transmission. There are many approaches available to solve congestion control and scheduling problem and most of them do not consider delay performance.

III. EXISTING SYSTEM

A typical optimal solution can be obtained by a duality approach that results into the back-pressure algorithm and a congestion-control component at the source node. Furthermore, a considerable amount of effort has focused on developing low-complexity and distributed scheduling algorithms that can replace the centralized back-pressure algorithm and yet still achieve provably good throughput performance. Like the back-pressure algorithm, these low-complexity scheduling algorithms are usually also queue-length-based. The drawback of these approaches, however, is that the end-to-end delay of the resulting queue-length-based scheduling algorithm is very difficult to quantify under certain cases the back-pressure algorithm can have poor delay performance.

The congestion control algorithm is based on window based flow control, which deterministically bounds each flow's end-to-end backlog within the network and prevents buffer overflows. Furthermore, each flow's throughput–delay tradeoff can be individually controlled. The algorithm is fully distributed and can be easily implemented in practice with a low per-node complexity that does not increase with the network size. It use a novel stochastic dominance method to analyze the end-to-end delay. This method is new and could be of independent value.

IV. PROPOSED SYSTEM

In the proposed system, optimal congestion control mechanism is applied using the deep learning. In deep learning, deep belief network is utilized to identify the optimal rate of transmission in multi stage operation. The data transmission is monitored in the destination by checking the packet seqno. If any seqno flip is occurred and if the corresponding seq numbered packet is not received in the specific time period then the transmission is marked as congested and the negative feedback is transmitted to the source device as negative acknowledgement. By using link layer detection process i.e., by transmitting RTS - CTS and data message transmission the current link failure detection process is achieved.

Once link failure occurs, node initiate route recovery process by sending reroute establishment message in unicast transmission and recovery is done by alternate sub trace establishment process in multicast transmission. Link failure prediction is performed by validating node position and its direction of movement to outside of its transmission range. If the link failure process is predetermined then it immediately initiates the route recovery process to avoid packet loss during data transmission. Traffic management process is done by classifying the incoming and outgoing data packet. The traffic manager prioritizes the real time data traffic over elastic traffic. For each packets priority is estimated and noted in the packets itself.

Traffic manager also monitors the incoming traffic level for load balancing. Traffic manager monitors traffic table to achieve load balancing and to prioritize the traffic. Whenever the negative feedback is received by the source node or if it failed to receive corresponding acknowledgement then the flow rate control mechanism is applied to decrease the transmission flow. This model uses the EWMA estimation in which current transmission and cumulate average transmission rate is considered to update the current transmission. The dynamic rate of the transmission is reduced whenever the congestion is occurred. If there is no congestion is occurred then the transmission rate is increased gradually. For each update, the current transmission rate is maintained in table. Along with this information, the transmission reliability in terms of successful transmission, transmission latency are stored

BACKPRESSURE NETWORK

Each flow's trade-off between throughput and delay can be individually controlled by the window size. Through this feedback channel, the destination node can send the ACK to the source node, and the source node can then decide if it is possible to inject another packet at the next time-slot. In reality, in order to reach the source node, each ACK will also go through the entire route in a hop-by-hop fashion in the reverse direction. Distributed election method is modeled to reserve the channel to transmit data over wireless medium.

For each time slot nodes have data or control packet to transmit, send election message over medium, which is dissimilar to RTs message in 802.11. The similarity during broadcasting is channel reservation and dissimilarity is election packet, where RTs is unicast. The priority assignment model added in MAC frame gives the priority to the nodes while sending the reservation packet. The nodes having the lower priority of data packet stop transmitting the packet in that slot. All nodes have equal priority to transmit hello and other control messages. Hence the priority based distributed channel election model outperforms compared to other channel reservation procedures.

Channel reservation is based on time and the amount of data transmission. Data transmission will be done based on the interference degree of the nodes. Distributed election method is modeled to reserve the channel to transmit data over wireless medium. For each time slot nodes have data or control packet to transmit, send election message over medium, which is dissimilar to RTS message in 802.11. The priority assignment model added in MAC frame gives the priority to the nodes while sending the reservation packet.

ADAPTIVE RATE

In rate adaptation model three types of rates are computed to manage the congestion. The Actual transmission rate can be calculated is based on current data transmission, virtual data rate transmission and standard deviation of virtual data transmission.

In traffic management the available band width will be accessed by the current traffic. If node capacity is possible to handle other traffic, remaining band width that was left by the first traffic will be accessed by the second traffic. Node will handle traffic according to the bandwidth availability.

Priority is assigned for all data packets. Priority order is Video streaming, Video transmission, Voice call, Audio, File and Data. Once packet priority is assigned packet is stored in corresponding Queue.

Multi Queue model is designed to buffer the packets. Three Queues are used to hold the packets are Real time queue, Non real time queue, Routing queue. Real time queue is used to buffer streaming, video, voice and audio. Non real time queue is used to buffer file and data. Routing queue is used to hold the control packets including hello, path discovery and path management message.

NETWORK CONSTRUCTION

All nodes create its neighbor list with specified expire time which is updated by the time of last hello message reception. If the expire time is less than the current clock time of the node, then it is removed from the neighbor list. Whenever node is removed from the neighbor list then it also removed from the forwarding route list. This will lead to dynamic updation of route which is used to handle routing packet. Hence route failure handling is effectively modeled in connection management.

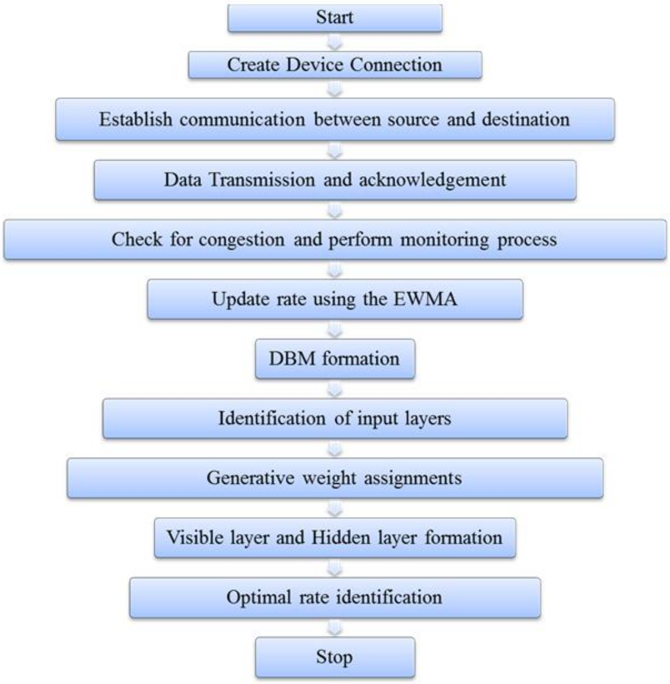

Figure 1 Flow Diagram

CONNECTION ESTABLISHMENT

1. By using Hello message and neighbor update timer, each and every node identifies its neighbor which is covered within the transmission range.
2. Source node tries to send the data packet to the intended destination.
3. It checks for the available route to reach the destination and if it is available then it get the available route and forward the data packet by using the selected path.
4. If path is unavailable it initiates the route discovery process by sending the route request message as network wide broadcast message.
5. Intermediate nodes rebroadcast the route request and destination node perform the best available path based on route selector procedure
6. Destination node sends reply to source node via the selected path as unicast message.
7. Upon receiving the route reply message intermediate nodes create routing table entry to reach the destination node.
8. Once Route is established source node immediately deque the buffered packet and transmit to the intended forwarder node.
9. Intermediate node receives the data packet and forward the packet until packet reaches the destination node.

OPTIMAL DATARATE ADAPTATION

During link failures, the reception of acknowledge in source node will get breaks. At the time source node blindly stops the packet or reduce the window size to lower value until receiving the data ack packet. At this stage, window size is reduced unwanted which is required at the time of congestion. In order to handle this, intermediate notification is required to stop the transmission for the specific time period which avoids the packet loss and also avoids the unwanted buffering in intermediate nodes.

For this purpose, intermediate node maintains the timer, which is used to wait for certain time period to hold the data transmission. This timer is initiated at the time of link failure. If the reply message is failed to receive before the timer expires, then intermediate node intimates the source node regarding the wireless loss. The packet is transmitted to source node by using the reverse path, once the source node receives the notification message then it holds the packet generation for the certain time period. For each data transmission, if source node unable to receive the acknowledgement due to the congestion loss, it estimates the packet transmission probability which is based on the receiver bandwidth, average buffer length of path, sender window size and receiver adv window size.

V. RESULTS & DISCUSSIONS

The performance evaluation is conducted to validate the execution of the proposed scalable backpressure routing in terms of packet related metrics such as PDR, Delay, and Throughput.

EVALUATION METRICS

PDR: PDR is the ratio between the number of packets successfully received and number of packets attempted for transmission is shown in Equation 1. It represents the success ratio of transmission over the wireless medium.

$$\text{PDR} = \frac{\text{Number of successful transmission}}{\text{Number of attempted transmission}} \quad (1)$$

Delay: Delay refers the average time taken to complete the end to end transmission of data packets from source to destination in the network using Equation (2).

$$\text{Delay} = \sum_{i=1}^{n} \frac{(\text{Packet received Time(i)} - \text{Packet sent ti}}{\text{n}} \quad (2)$$

Throughput: Throughput outcomes the number of bits transmitted per unit time. It is calculated from the size of the data packet, and total number of received data packets with the transmission duration using the Equation (3).

$$\text{Throughput} = \frac{\text{Total number of packets received} * \text{Packet size} * 8}{\text{Transmission Duration}} \quad ($$

EVALUATION RESULTS

The results achieved by proposed optimal backpressure algorithm compared to the existing routing protocols in terms of PDR are shown in Figure 2. Increasing the messages in the network is directly affecting the PDR performance of the protocol. In the PDR evaluation, the existing protocols achieved only 85.55% to 92.9% performance while increasing the number of messages in the network.

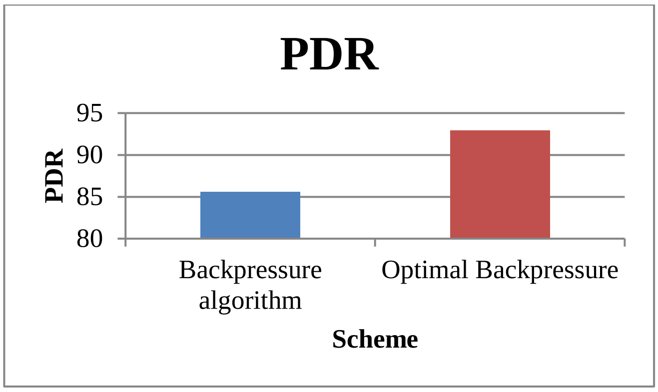

Figure 2 PDR Evaluation

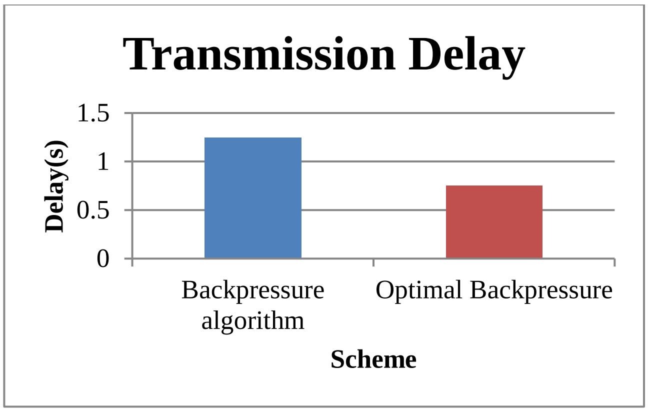

Figure 3 Transmission Delay

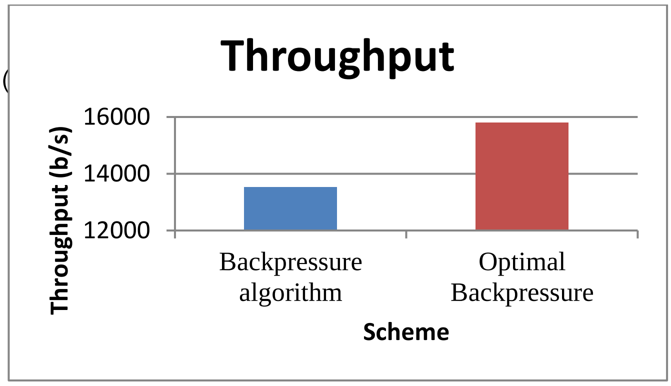

Figure 4 Throughput

The proposed protocol maintains the significant performance in PDR ranged in 92.9% compared to backpressure algorithm.

Figure 3 illustrates the delay performance of the backpressure algorithm which is significantly lower then the existing scheme.

The proposed system obtained the significant improvement in throughput metric is shown in figure 4. From the observation, it is understood that the Throughput in proposed scheme is higher than the existing scheme.

VI. CONCLUSION

The proposed algorithm, a cross layer protocol for wireless MANET generalizes the channel access management and routing process which includes traffic management, connection maintenance and distributed scheduling for concurrent transmission. The integrated components sharply works together to provide better outcomes for various performance measures in end-to-end delay, throughput, PDR, Goodput and bandwidth utilization for wireless network. The system produced an optimal solution to handle routing problem and connectivity problem based on data adaptation. The connection between the devices is established and data transmission is performed. The transmission is performed with the acknowledgement which provides the reliable in the communication. During the data transmission, the monitoring is performed to compute the incoming and outgoing transmission rates. In further, the system can be improved using the deep learning model with the deep belief networks. This will significantly improves the performance of the backpressure network in wireless communication.

VII. REFERENCES

[1] Saedi, T. and El-Ocla, H., 2021. TCP CERL+: revisiting TCP congestion control in wireless networks with random loss. Wireless Networks, 27(1), pp.423-440.

[2] Khan, A.N., Tariq, M.A., Asim, M., Maamar, Z. and Baker, T., 2021. Congestion avoidance in wireless sensor network using software defined network. Computing, 103(11), pp.2573-2596.

[3] Malarvizhi, K. and Jayashree, L.S., 2021. Dynamic scheduling and congestion control for minimizing delay in multihop wireless networks. Journal of Ambient Intelligence and Humanized Computing, 12(3), pp.3949-3957.

[4] Li, Y., Sun, X., Zhang, H., Li, Z., Qin, L., Sun, C. and Ji, Z., 2021. Cellular Traffic Prediction via a Deep Multi-Reservoir Regression Learning Network for Multi-Access Edge Computing. IEEE Wireless Communications, 28(5), pp.13-19.

[5] Zhang, A., Sun, M., Wang, J., Li, Z., Cheng, Y. and Wang, C., 2021. Deep Reinforcement Learning-Based Multi-Hop State-Aware Routing Strategy for Wireless Sensor Networks. Applied Sciences, 11(10), p.4436.

[6] Biradar, A & Thool, RC 2014, 'Reliable genetic algorithm based intelligent routing for MANET', in Computer Applications and Information Systems (WCCAIS), 2014 World Congress on, pp. 1-8.

[7] Du, Z, Wu, Q, Yang, P, Xu, Y & Yao, Y-D 2014, 'User-demand-aware wireless network selection: A localized cooperation approach', IEEE Transactions on Vehicular Technology, vol. 63, no. 9, pp. 4492-4507.

[8] Francini, A & Chiussi, FM 2002, 'Providing QoS guarantees to unicast and multicast flows in multistage packet switches', IEEE Journal on Selected Areas in Communications, vol. 20, no. 8, pp. 1589-1601.

[9] Garcia-Luna-Aceves, J & Menchaca-Mendez, R 2012, 'STORM: a framework for integrated routing, scheduling, and traffic management in ad hoc networks', IEEE Transactions on mobile computing, vol. 11, no. 8, pp. 1345-1357.

[10] Gundry, S, Urrea, E, Uyar, MÜ, Conner, M, Bertoli, G & Pizzo, C 2010, 'Convergence analysis of genetic algorithms for topology control in manets', in Sarnoff Symposium, 2010 IEEE, pp. 1-5.

[11] Howitt, I 2001, 'WLAN and WPAN coexistence in UL band', IEEE Transactions on Vehicular Technology, vol. 50, no. 4, pp. 1114-1124.

[12] Huang, J & Liu, Y 2010, 'MOEAQ: A QoS-aware multicast routing algorithm for MANET', Expert Systems with Applications, vol. 37, no. 2, pp. 1391-1399.

[13] Huang, J, Berry, RA & Honig, ML 2005, 'Wireless scheduling with hybrid ARQ', IEEE Transactions on Wireless Communications, vol. 4, no. 6, pp. 2801-2810.

[14] Iqbal, M, Wang, X & Wertheim, D 2010, 'Reliable multimedia multicast communications over wireless mesh networks', IET communications, vol. 4, no. 11, pp. 1288-1299.

[15] Ji, L & Corson, MS 2001, 'Differential destination multicast-a manet multicast routing protocol for small groups', in INFOCOM 2001. Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings. IEEE, vol. 2, pp. 1192-1201.

[16] Jia, W-K, Chen, C-Y & Chen, Y-C 2014, 'ALEX: An arithmetic-based unified unicast and multicast routing for MANETs', in 2014 IEEE Wireless Communications and Networking Conference (WCNC), pp. 2114-2119.

[17] Le, J, Lui, JC & Chiu, D-M 2010, 'DCAR: Distributed coding-aware routing in wireless networks', IEEE Transactions on mobile computing, vol. 9, no. 4, pp. 596-608.

[18] Li, X, Jia, Z, Zhang, P, Zhang, R & Wang, H 2010, 'Trust-based on-demand multipath routing in mobile ad hoc networks', IET information security, vol. 4, no. 4, pp. 212-232.

[19] Li, Y & Ephremides, A 2007, 'A joint scheduling, power control, and routing algorithm for ad hoc wireless networks', Ad Hoc Networks, vol. 5, no. 7, pp. 959-973.

[20] Liang, S, Chen, S, Ding, X, Zhang, C & Xu, Y 2011, 'A broadcasting algorithm of multipath routing in narrowband power line communication networks', in Communication Software and Networks (ICCSN), 2011 IEEE 3rd International Conference on, pp. 467-471.

Cite this article as :

Aarthi S, Dr. S. Jothi Lakshmi, "Optimal Backpressure Data Transmission Using Deep Learning", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 8 Issue 4, pp. 349-358, July-August 2022.

Journal URL : https://ijsrcseit.com/CSEIT228459