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An optimized approach to network congestion avoidance using the blue algorithm

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Abstract

Research on congestion management and avoidance mechanisms is required since, as data use has been on the rise, current algorithms are struggling to keep up with demand and will need to be improved in the future. With respect to packet loss rates and buffer space requirements, blue is shown to be a much superior algorithm than red via the use of both controlled tests and simulations. The Blue algorithm targets packet loss and connection utilization to provide congestion management. In contrast to every other Active Queue Management technique, blue employs queue length to gauge network congestion. In order to decrease the dimensionality of the neural network structure, the input characteristics of the Bus System are selected using an angular distance-based clustering algorithm. Both online and offline modes of congestion management may make use of the suggested approaches.

Keywords: Congestion, blue algorithm, networks, wireless and avoidance

Introduction

Smartphone ad hoc networks use pre-existing hardware, such as Wi-Fi and Bluetooth, and operating system protocols developed on smartphones to build participant networks without depending on the cellular network infrastructure, access points, and other kinds of traditional network infrastructure gear, in contrast to more traditional networks like Wi-Fi Direct, allow for multi-hop relays. A multi-hop relay is a method of transmitting data between nodes that makes use of an intermediate node.

Better sensors and portable devices with wireless transceivers make up a Wireless Sensor Network (WSN), a self-organizing and infrastructure-less wireless network Gathering data from the environment, keeping tabs on it, and transmitting it to a sink node for analysis is what sensors are all about. Responses from the sensor node are being relayed via the control nodes, sensor nodes experience congestion while transmitting data to a control station.

Because they are so difficult to access without authorization, wired networks provide high security. The consistent and dependable download and upload speeds of wired networks are eco-friendly. Data is not susceptible to speed variations or interference from other wireless devices since networks are linked by wires and not over the air.

Decreased infrastructure requirements are associated with sensor networks and the nodes that house them. Using the access point, it is simple to locate sensor nodes linked to the wireless network to link up with other nodes that can exchange data, it employs an access point. One disadvantage of sensor networks is the constant need for access points. To illustrate a mobile network, the cellular network is ideal. this is the primary network for inspecting and communicating with all networks.

When it comes to old-school communication, wireless networks are crucial. In the past, the military, emergency services, and law enforcement agencies were the main users of wireless technology. The use of wireless communications has skyrocketed in recent years. The number of people using the internet has skyrocketed in the last century, and many now access it via their mobile phones. Voice and data

connections with a modest data transmission rate were the major focusses of the first generation.
The administration of the WSN does not need much elaboration. Many individuals are using the wireless sensor network. The administrative section areas and the management level are the two most prevalent uses of the Wireless Sensor Network. Anyone in charge of a wireless sensor network has to be familiar with both conventional management practices and the latest evolutionary trends. It is important to take into account different kinds of network characteristics while designing a Wireless Sensor Network with new dimensions and management principles. It is important to share the dynamics of wireless sensor networking for both environmental monitoring and development.

Literature Review

Wang *et al*. (2019) [1] Experimental findings using model-based mobility data and the proposed LSTM framework for single-user trajectory tracking demonstrate the efficacy of LSTM in making predictions by utilizing pre-learning of user-specific mobile nodes. Additionally, a method for predicting geographic areas and a system for multi-user, multi-step prediction based on long short-term memories (LSTM) were both made accessible. In experiments conducted on genuine datasets, the proposed framework proved to be more effective than its rivals. This proves not just its robustness and reliability for multi-step predictions, but also its capacity to generalize for predictions made by different users.
Koushik and Vetrivelan, (2020) [2], By first locating the neighbor nodes within a given cross range using a Cartesian-based localization technique and then analysing their mobility pattern using an LSTM prediction model, the suggested algorithm for PSO (particle swarm optimization) allows for the selection of the best relay nodes. We compare the results of the proposed technique to four others, including Max Prop, Spray & Wait, Epidemic, and two others that are already in use. With fewer hops, less time, and better packet delivery ratio and overhead ratio, the proposed method works admirably, according to the comparison of the data.
Durachman (2020) [3] For the purpose of providing machine learning techniques grounded on mobility prediction, use gradient boosting devices developed for the system to foretell and mimic the motion of specific nodes inside an ad hoc mobile network. The proposed method provides much better prediction accuracy and beats previous models in predicting mobility in both real-world and simulated contexts. Accuracy improves the performance level of the suggested mobility indicator in ad hoc mobile networks. Improve your routing performance, increase your packet success rate, and raise your throughput with the help of NS *et al*.'s (2020) robust routing technique that uses artificial neural networks to anticipate mobility. Each stage of the procedure is split down into a module.
Pal *et al*. (2020) [4]: The two primary components of the suggested model for predicting separate multi-path routing algorithms are described below by Select the stable neighbours of each node and use them to construct a path between the starting point and the destination. Using a route with steady nodes may help reduce connection difficulties and lost packets. Make use of the ERNN model to foretell the actions of the network nodes based on their historical behavior. Locating the stable nodes will be much easier with this. Apply the route-discovery process to find the number of disjo-input trees that use the stable neighbours to get from source to destination once you've identified them. A number of paths are created between the source and destination pairs in this method. Using this run-time path technique, new routes may be created without interfering with the current routes of the multi-paths, and the least amount of delay feasible will be ensured during packet transit.
Jin *et al*. (2020) [5] present a relay strategy that employs recurrent neural network (RNN) trajectory prediction to identify the optimum relay vehicle for data transfer. The suggested approach ensures the timely delivery of data by employing distributed learning and trajectory prediction to choose the optimum vehicle for data transfer. Lastly, we demonstrate the algorithm's performance via a number of simulations. The proposed method enhances both the accuracy of the predicted driving trajectory and the timeliness of the data, according to the results.

Research Methodology

As network traffic continues to grow at an exponential pace, the Internet Engineering Task Force (IETF) has explored active queue management strategies such as Random Early Detection (RED) to slow down the rate of packet loss. Active queue management may significantly lower Internet packet loss rates, in contrast to the present methods' ineffectiveness un avoiding high loss rates. One inherent flaw in these algorithms is that they rely on queue lengths to measure the intensity of congestion. This observation presents enhanced blue, an alternative active queue management method. In order to control congestion, BLUE makes advantage of packet loss and link idle events. With respect to packet loss rates and buffer space requirements, blue is shown to be a much superior algorithm than red via the use of both controlled tests and simulations.

Data Analysis

The Blue algorithm targets packet loss and connection utilization to provide congestion management. In contrast to every other Active Queue Management technique, blue employs queue length to gauge network congestion. The packet is marked or dropped in blue using a drop probability Pm. The dropping chance of Blue will not be raised until the buffer is full or the connection becomes idle, as the link probability Pm is lowered when the queue is empty or idle.
Freeze Time (Ft), d1, and d2 are additional factors used by Blue to determine the timing and manner of Pm adjustments. The minimum time gap between two consecutive updates of Pm is governed by Freeze Time. Assuming the queue is empty or idle, Pm increases d1 and decreases d2 in the event of an overflow.

The basic blue algorithm is

Upon packet loss (or Q > L) event:	Upon queue empty or link idle event:
Min_Int ← *New – Last_Update*	*Min_Int* ← *New – Last_Update*
If (Min_Int > F_I*) then*	*If (Min_Int >* F_I*) then*
$P_m \leftarrow P_m + d_1$;	$P_m \leftarrow P_m - d_2$;
Last_Update ← *New;*	*Last_Update* ← *New;*

From the above algorithm, it shows that Blue is simple in contrast to RED.

A network is constructed using n-number of linked nodes in node creation. In a network, nodes may communicate with one another by requesting data. Step two involves using the improved blue algorithm to assess the queue size, which is part of the size and data forwarding verification procedure This is where the gateway verifies the negative received acknowledgement. In such case, the data is retransmitted by the gateway to a backup node at the destination.

By monitoring the queue size, the improved blue algorithm helps TCP prevent packet loss. The packets are sent immediately from the gateway to their destination if the queue size is large. The gateway will send the compressed packet on its route if its size is less than the specified threshold. The receiver responds to the sender by sending an acknowledgement over the gateway. The gateway checks the acknowledgement and removes the packet from backup if it's affirmative; if it's negative, the gateway resends the packet to its original destination. There are four main components to the Enhanced Blue algorithm's system architecture:

- Node construction
- Verification of size and data forwarding
- Data compression with notification
- Data backup based on the acknowledgement

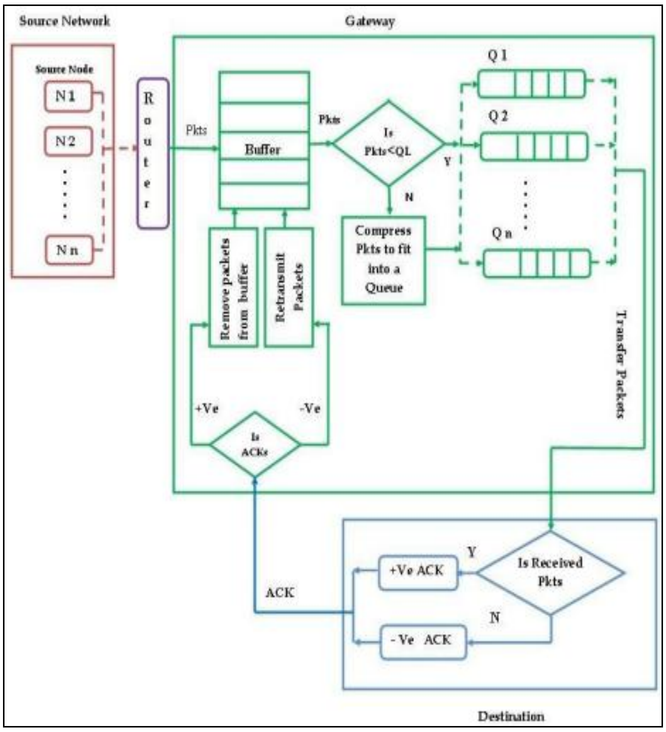

Fig 1: System Architecture diagram of congestion control for Enhanced Blue Algorithm

Enhanced Blue Algorithm
For ∀ Pkt_1 *to* Pkt_n *do*
For ∀ Q_1*_Size to* Q_n*_Size do*
If (Q_x*_Size <= MAX) then*
Transfer the Pkt_x *using* Q_x
Else
Compute Q_x *_RemSize =Size (*Q_x*)-* Q_x*.freespace()*
$CPkt_x$ ← *(Compress (*Pkt_x*., *Q_x *_RemSize)*
If (CPktx Size <= Q_x*_Size)*
$Q_x \leftarrow CPkt_x$
For ∀ ACK from destination
If (ACK == 1)
Remove Pkt_x *from gateway forward ACK to Source*
Else
Retransmit Pkt_x

The packet size is less than the minimum. The gateway will compress the data packets before sending them to their destination if the packet size is set to Maximum. The packet is acknowledged by the gateway after it has arrived at its destination

Here we will compare the performance of improved Blue with the current improved AODV (EAODV) method:

Various metrics are used to conduct performance studies of the improved blue version of the previous EAODV. The criteria that were used for this comparison are as follows.

End-to-End Delay

Packet Delivery Ratio

Packet Loss Ratio

Throughput

End-to-end delay

In General, Packets are delivered from source to destination nodes with delays, which vary from packet to random packet manners of end-to-end packet delay.

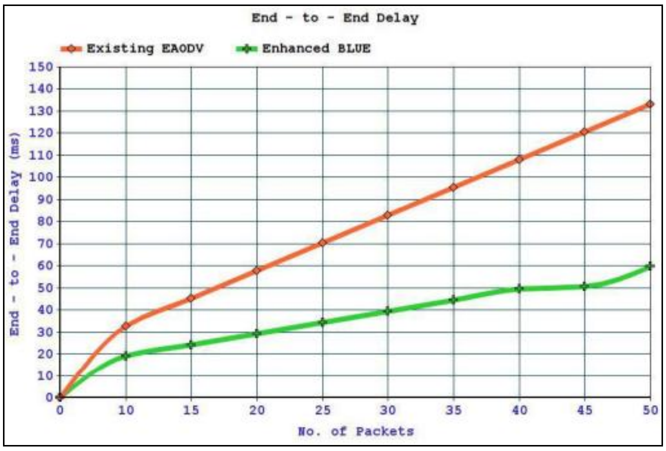

Fig 2: End-to-End Delay comparisons between Existing EAODV with Proposed Enhanced Blue

The average end-to-end latency between EAODV and the improved Blue, Various packets have been used to get the simulated result. Equation 3.13 yielded the values shown in Table 1. Enhanced Blue has an average end-to-end latency of just 19.11 ms, in contrast to EAODV's 32.63 ms for a packet size of 10. In both scenarios, the end-to-end latency grows in direct proportion to the number of packets sent.

Table 1: End-to-End Delay Comparison between EAODV and Enhanced Blue

No. of Packets (128 Bytes/pkt.)	No. of Hops	Propagation Delay (ms)	Queue Delay EAODV (ms)	End to End Delay EAODAV (ms)	Queue Delay Enhanced Blue (ms)	End to End Delay Enhanced Blue (ms)
10	5	0.002	22.52	32.63	9.009	19.11
20	5	0.002	47.55	57.75	19.019	29.22
30	5	0.002	72.57	82.88	29.029	39.34
40	5	0.002	97.60	108.01	39.039	49.45
50	5	0.002	122.63	133.14	49.050	59.56

According to the data in the table, for a total of 50 packets sent, the average delay in the current EAODV is 133.14 ms, whereas in the improved Blue it is 59.56 ms, a difference of 73.58 ms.

Packet Delivery Ratio

To determine the efficiency of packet delivery, one subtracts the number of packets received from the number of packets actually transferred within a certain time frame. Equation 3.14 compares EAODV with the improved blue algorithm with respect to the average packet delivery ratio; Figure 3 displays the results.

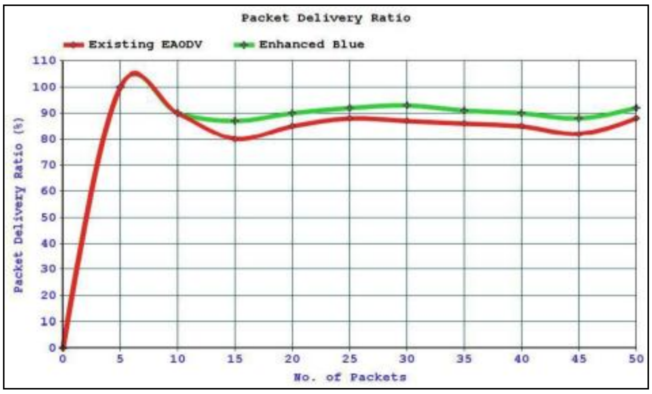

Fig 3: Packet Delivery Ratio comparison between Existing EAODV with enhanced Blue

Packet Loss Ratio

Some packets do not arrive at their destinations during transmission. To get the packet loss, take the sum of all the packets sent and subtract the sum of all the packets received by the recipient.

In Figure 4, we can see that EAODV and the improved blue algorithm have different percentages of packet loss ratios. The data packet loss % is shown in the simulation result.

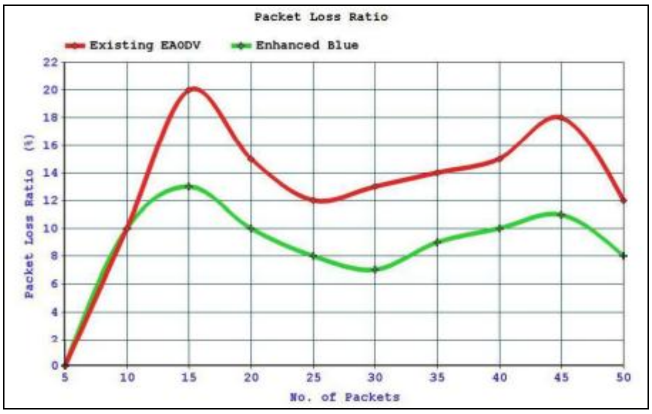

Fig 4: Packet Loss Ratio comparison between Existing EAODV with enhanced Blue

Throughput

The sum of total numbers of packets transferred from the source to destination within a stipulated time.

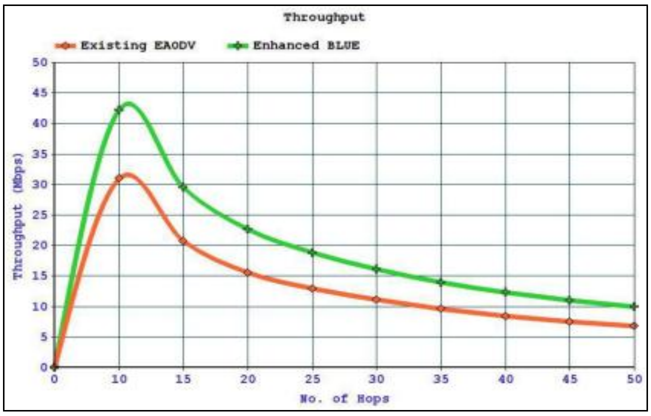

Fig 5: Throughput comparison between Existing EAODV with enhanced Blue

Table 2: Throughput comparison

Number of Hops	Packet Size (MB)	EAODV (Mbps)	Proposed ENHANCED BLUE (Mbps)
10	1	30.941	42.230
20	1	15.547	22.645
30	1	11.121	16.108
40	1	8.423	12.303
50	1	6.779	9.952
Average Throughput		14.562	20.647

Conclusion

The blue algorithm, with a primary emphasis on avoiding congestion. In this case, TCP variation is used to manage the numerous queues at the gateway in order to prevent packet loss. The packets are transmitted straight from the gateway to their destination if the available queue size is large relative to the packet size. This observation presents enhanced blue, an alternative active queue management method. In order to control congestion, BLUE makes advantage of packet loss and link idle events. Because they are so difficult to access without authorization, wired networks provide high security. The consistent and dependable download and upload speeds of wired networks are eco-friendly. Data is not susceptible to speed variations or interference from other wireless devices since networks are linked by wires and not over the air. At the gateway, an Explicit Congestion Notification (ECN) algorithm is used to notify the sender of the current network condition in order to reduce the transmission speed of packets.

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