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Implementation of CA-AOMDV Protocol using ANN

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Abstract *: Mobile Ad Hoc network is a self-organizing infrastructure less network where the nodes are responsible for routing the packets. MANET has dynamic topology which allows nodes to join and leave the network at any time. This paper proposes a channel adaptive routing protocol which extends AOMDV routing protocol to accommodate channel fading. The proposed Channel Aware AOMDV protocol uses channel average nonfading duration to select stable links for route discovery. The main objective of this paper is to demonstrate approximation capability of artificial neural network. Feed forward network architecture with back propagation algorithm is used. Depending upon the size of database number of hidden layers and number of neurons in hidden layer are decided. Number of neurons in hidden layer is varied and effect on percentage deviation in the output parameter is observed. Depending upon nature of input and output parameters synthesis and analysis artificial neural network (ANN) models are trained.*
Keywords: *Mobile Ad-hoc networks, Channel Aware Ad-hoc On Demand Multipath Distance Vector (CA-AOMDV), ANN*

I. INTRODUCTION

A mobile ad hoc network (MANET) is a infrastructure less network where mobile devices are connected by wireless. And these mobile devices from MANET are free to move at any direction, and because of this these nodes changes its links to other nodes. MANET is Wireless ad hoc network which has a routable networking environment on the top of a Link Layer ad hoc network.

The design of ad-hoc network faces many challenges. The first thing is that source node and destination node from the ad hoc network may be mobile including nodes which are forwarding data packets within the network[1]. As we know transmission range of wireless network is limited, and if one of the neighboring node moves out of the range within the network then there are chances of breaking the link between the nodes while broadcasting data packets. A second thing is the absence of centralized control which makes the ad hoc networks design complicated. The dynamic changes in the topology of MANET make routing as a challenging task, as the existing path is rendered inefficient and infeasible.

The major issues for mobile ad hoc networks are medium access control (MAC), routing, security and quality of service provisioning. The paper addresses the routing problem in a mobile ad hoc network without considering the other issues such as access control, security and QoS factor. Routing in MANET defined as "the directed flow of data from source to destination maximizing the network performance". This paper introduces the enhanced version of AOMDV which is a routing protocol. And this protocol allows us to work the principle of ebb-and-flow if their path is available. Which allows the reusability of paths which is not available because of breaking of links within the nodes, so instead of discarding those paths these paths are reused [2]. And this improved routing protocol has improved routing decisions which results into the improvement in robustness of the network. This protocol is called as Channel-Aware AOMDV (CA-AOMDV) [1], which has 25 percent performance improvement as compare to AOMDV protocol.

By using CA-AOMDV protocol simulations are done with the help of network simulator (NS-2). And based on these simulations database is made which consists of Bandwidth, speed of nodes and number of nodes as input parameters and throughput and end-to-end delay as output parameters. Based on these input parameters, output parameters are calculated.

II. HEADINGS

1. Introduction

As we know MANET that is Mobile ad hoc network do not having a fixed infrastructure. Which mean MANET is different from other wireless LANs because of absence of any fixed infrastructure[9]. But on other hand cellular network has a fixed base station so mobile node from ad hoc network can directly communicate with other node directly which is within its transmission range[3]. And if one of the node is outside to its transmission range then data packets transferred through intermediate nodes using a store-and-forward multi hop transmission principle. All nodes are responsible to transfer packets on the behalf of other nodes from ad hoc network. Hence, such a mobile ad hoc network is also called as a multi hop wireless network.

This paper introduces the enhanced version of AOMDV which is a routing protocol. And this protocol allows us to work the principle of ebb-and-flow if their path is available[4]. Which allows the reusability of paths which is not available because of breaking of links within the nodes, so instead of discarding those paths these paths are reused? And this improved routing protocol has improved routing decisions which results into the improvement in robustness of the network. This protocol is called as Channel-Aware AOMDV (CA-AOMDV).

2. Design of CA-AOMDV Protocol

Data packet transmissions over unreliable wireless connections may results into the large packet losses. In this case its best to use channel- aware routing protocol which is extends the Ad hoc On-Demand Multipath Distance Vector (AOMDV) routing protocol. And we call this protocol as CA-AOMDV. As Ad hoc On-Demand Multipath Distance Vector (AOMDV) is an extension of the Ad hoc On-Demand Distance Vector (AODV) routing protocol. The key difference between AOMDV and AODV is that AOMDV provides multiple number of paths from source node to destination node. And all these paths are mutually link-disjoint and loop free. Routing table entries for AOMDV protocol is slightly modified which allows maintaining multiple paths and multiple entries within the routing table[2]. The advertised hop-count replaces hop-count and advertised hop-count replaces liable from the current node to destination node. Next-hop IP address is replaced by the list of all next-hop nodes and hop-counts of the paths to the destination from that node, as like this :

<destination IP address,
destination sequence number,
advertized hop-count,
route list: {(next hop IP 1, hop-count 1),
(next hop IP 2, hop-count 2), . . . },
entry expiration time>.

And routing table of CA-AOMDV protocol consists of following entries-

<destination IP address,
destination sequence number,
advertized hop-count, route list:
{(next hop IP 1, hop-count 1),
(next hop IP 2, hop-count 2), . . . },
entry expiration time,
handoff dormant time>.

By using CA-AOMDV protocol simulations are done with the help of network simulator(NS-2). And based on these simulations database is made which consists of Bandwidth, speed of nodes and number of nodes as input parameters and throughput and end-to-end delay as output parameters. Based on these input parameters output parameters are calculated. Input and output parameters are as shown in Table I.

III. Application of ANN using CA-AOMDV Protocol

In the available artificial neural networks feed forward multi layer network is selected. Input and output parameters of ANN are summarized in Table 1. Input parameters and output parameters are called as physical and performance parameters respectively[1]. Combinations of Physical parameters will lead to combination of performance parameter ANN is used to determine best possible combination of physical parameters are for desired performance parameters. Depending upon arrangements of physical and performance parameters ANN model has two types as

3.1) Synthesis ANN model
3.2) Analysis ANN model

3.1 Synthesis ANN model

Synthesis ANN model has physical parameter of antenna as an Input and performance parameters as an Output. This model used to determine best combination of performance parameters, when trained with appropriate accuracy, Synthesis ANN model is shown in Fig. 1.

3.2 Analysis ANN model

An analysis ANN model is described in the Fig. 2 Analysis model shown in fig.4 is used to determine the best combination of physical parameters, when trained. Analysis model is reverse trained and weights are adjusted till desired accuracy.

Neural network needs training for which database is required. In this work, training database is prepared with the help of network simulator. Input parameters are varied for each combinations Output parameters are prepared. Using combinations of Input and Output parameters total 144 samples are obtained. Out of which 120

samples are used for training and 24 samples are used for testing. Testing pairs are arbitrarily selected from database but it is insured that it would covered variations in the Input and Output parameters.
After preparing database, Network architecture is design. Number of hidden layer of depends upon number of training pairs[3]. The relation between number of training pairs and weights which are related with number of Neurons is given in equation 1.

If accepted accuracy a = 10^{-5} then $w \cong 120$. So number of weights put limit on number of neuron's in hidden layer. The Hidden layer can consist of maximum 12 neurons and number of hidden layers is 1.Next task is to find out optimizes value of number of neuron's in hidden layer. ANN should be trained and tested with training and testing database. For training of feed forward network back propagation algorithm is used. MATLAB is used for creating training and testing of neural network.
For training of ANN following parameters are selected.

i. Back propagation network training function Levenberg'marquard.
ii. Transfer function for hidden layer 'tansig'.
iii. Transfer functions for Output layer 'purelin'.
iv. Performance function mse (mean square error).
v. Performance goal $10e^{-5}$
vi. Number of epochs 500.

IV. Result of Synthesis ANN Model

As per equation 1, maximum number of neurons in hidden layer is 12. Initial value of number of neurons is selected as 2. Neuron network is trained with 2 neurons in hidden layer. Number of neurons is valid up to 11 as maximum value is 12. During every iteration parameter wise percentage deviation is calculated and then average percentage deviation is calculated. For every value of number of neurons, average percentage deviation is shown in table II. It can be observed that percentage deviation during testing is more as compared to training database. This is due to network behavior for inputs other than training samples.

From Table II, it can be concluded that minimum percentage deviation would be with the network having number of neurons between 7 and 10. One more time neural network is trained with number of neurons equal to 9. Results are shown in Table III.
From Table III, it is concluded that 9 would be the best value for number of hidden layer, synthesis ANN model is trained and then tested for one input-output parameter combination. To check performance of synthesis model, one arbitrary input combination is selected. Table IV shows parameter wise percentage deviation between value chosen manually from database and result given by ANN.
It can be observed that synthesis model got trained with acceptable values of deviations in output parameters. Synthesis model shows zero deviation in case of number of nodes.

V. Results of Analysis ANN model

The aim of analysis ANN model is to find out the best possible combination of input parameters. So training must be carried out in reverse direction. For training in reverse direction same procedure is carried out. The results are carried out in Table V. Table V shows, variation on average percentage deviation with number of neurons in hidden layer. Same training and testing database is used but in opposite direction. From Table V, it can be concluded that minimum percentage deviation would be with the network having number of neurons between 7 and 11. When neural network is trained with no. of neurons is equal to 9 then results are shown in Table VI.

Table VI shows that 9 would be the best value for number of hidden level; Analysis ANN model is trained and then tested for one Input Output parameter combination. To check performance model again one arbitrary combination of physical parameter is selected. Then manually chosen values of physical parameters are compared with the values given by analysis ANN model after training. Table VII shows that the percentage derivation between physical parameters.

Table VII shows good matching results between physical parameters which are manually choose and values given by ANN. This indicates that ANN got trained in reverse direction good approximations of physical parameters. This is used to find out best combinations of physical parameters. Now desired values of performance parameters are chosen. These values are given as Input to analysis ANN model, which is properly trained. Analysis ANN model gives physical parameters as Output which are shown in table VIII. Performance parameter values are chosen manually but these values are desired values. Table VIII shows physical parameter values given by trained analysis ANN model for desired values of performance parameters. Physical parameters given by synthesis ANN model as shown in table IX.

VI. INDENTATIONS AND EQUATIONS

$$\rho = \frac{w}{1-\alpha} \qquad (1)$$

Where ρ = Number of training pairs

w = Number of weights

α = Expected accuracy

VII. FIGURES AND TABLES

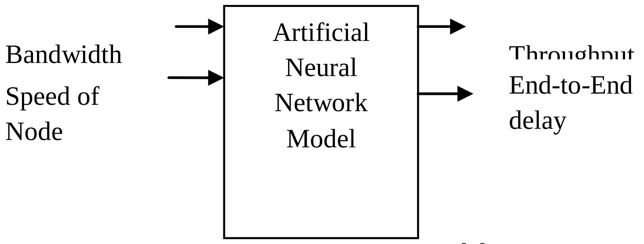

Fig. 1. Syntesis ANN Model

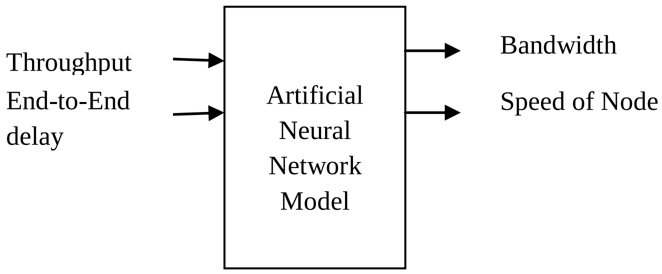

Fig. 2. Analysis ANN model

TABLE I
Input and output parameters

Sr. No.	Input Parameters	Output Parameters
1.	Bandwidth	Throughput
2.	Speed of Node	End-to end Delay

TABLE II
Variation of percentage deviation with no. of neurons in Synthesis Model

No of Neurons in Hidden Layer	No. of epochs required	Average Percentage Deviation	
		Training	Testing
2	21	9.62	12.23
3	12	4.68	8.46
5	7	3.88	7.76
7	16	3.65	6.68
10	3	3.82	7.64
11	6	4.31	8.78

TABLE III
Variation of percentage deviation with no. of neurons in Synthesis Model

No of Neurons in Hidden Layer	No. of epochs required	Average Percentage Deviation	
		Training	Testing
9	14	3.23	6.65

TABLE IV
Comparison of result between chosen physical parameters and ANN Synthesis Model

Parameter	Value Chosen Manually	Result Given By ANN	Percentage Deviation
Bandwidth	100	98.768	1.232
Speed of Node	50	49.21	0.79
No of Nodes	10	10	00

TABLE V
Variation of percentage deviation with no. of neurons in Analysis Model

No of Neurons in Hidden Layer	No. of epochs required	Average Percentage Deviation	
		Training	Testing
2	28	3.19	4.21
3	30	3.22	5.63
5	65	2.65	3.87
7	10	2.34	5.20
10	41	2.52	4.78
11	24	2.75	5.28

TABLE VI
Variation of percentage deviation with no. of neurons in Analysis Model

No of Neurons in Hidden Layer	No. of epochs required	Average Percentage Deviation	
		Training	Testing
9	15	2.21	3.75

TABLE VII
Comparison of result between chosen
physical parameters and ANN Analysis Model

Parameter	Value Chosen Manually	Result Given By ANN	Percentage Deviation
Throughput	100	99.622	0.378
End-to-End Delay	0.1897	0.1728	0.016

TABLE VIII
Physical parameters given by Analysis ANN Model

Sr. No.	Performance Parameter	Desired Value	Physical parameter	Result given by ANN
1	Bandwidth	100	Throughput	99.187
2	Speed of Node	50	End-to-End Delay	0.176
3	No. of Nodes	10		

TABLE IX
Physical parameters given by Synthesis ANN Model

Sr. No.	Performance Parameter	Desired Value	Physical parameter	Result given by ANN
1	Throughput	100	Bandwidth	98.783
2	End-to-End Delay	0.1897	Speed of Node	49.134
3			No. of Nodes	10

VIII. CONCLUSION

Design of Channel Aware Ad hoc On-demand Distance Vector Routing Protocol (CA-AOMDV) is carried out. Artificial Neural Network is used to predict the best possible combination of performance parameters. For training number of neurons in hidden layer are decided after experimentation. Training is carried out for both synthesis and analysis model. It can be observed that match between results given by CA-AOMDV and ANN is acceptable. Desired values of performance parameters are given to trained ANN model and physical parameters obtained from analysis model.

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