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Pricing Pitch to Optimize QoS in MANETs and Statistical Verification for its Hypothetical Measurements

M.Sulleman Memon[1ψ], Manzoor Hashmani[2], Niaz A. Memon[3] and Niaz Memon[4]
[1,3]Department of Computer Systems Engineering/IT, Quaid e Awam UEST, Nawabshah, Pakistan
[2]Department of Computer Systems Engineering/SWE Mehran UET, Jamshoro, Pakistan
[4] Department of Civil Engineering, Quaid e Awam UEST, Nawabshah, Pakistan

Abstract. In this paper we have given pricing pitch for resource reservation about prioritized traffic in MANETs .This scheme is for use of MANETs in commercial production, emergencies, mission critical and broadcasting scenarios where real time transmission require guaranteed QoS. Some hypothetical measurements are performed on some experimental data and then for validation of that scheme, we use Multi Layer Perception Automated Neural Network Model (MLPANN) by using only one input, one hidden neuron and one out put neuron. The model was tested on different training Algorithms with different BFGs. Very excellent results are found with minimum ration of errors approximately equals to zero. This is entirely new approach to use ANN in MANETs for designing a pricing pitch

Keywords : Pricing Pitch, Hypothetical Measurements, Premeditated Policies, Prioritized Traffic, MLP

1. Introduction

There is a variety of fields where ad hoc networks are used such as cooperative information sharing, defense applications, disaster management but mission critical applications and commercial production applications are new, most demanding, attention appealing and market oriented fields of applications for these networks which mostly , contain real time audio and video streams.[1]. All this set of applications is miscellaneous, ranging from small to large areas and devices may be static or mobile up to very high dynamic network. Considering the high mobility network, topology of network may change rapidly and unpredictably, therefore mobiles are required to be skilled so that they can work in decentralized environment and from handling the message delivery to topology management is performed by them automatically. To achieve the goals of this connectivity researchers have divided ad hoc networks in to two categories as close networks in which all nodes cooperate each other to forward information to achieve a common goal such as in emergencies and in open networks in which different nodes with different goals share their resources for global connectivity.

In multi hop networks there exits multiple possible routes from source to destination. Here we refer to two concepts of Path diversity in which it is considered that multiple routes exists between source and destination each with different characteristics (such as no of hops, bandwidth available, time to reach etc) . The other concept is of time diversity in which it is considered that because of mobility different traffic flows routes between nodes keep changing over time. For each node to fulfill its target with definitive performance both path and time must be subjugated. With reference to routing and resource utilization in past the least cost route was selected from available routes based on auction but a very little or no work has been performed to consider QoS issues regarding the pricing with respect to the service that a source require from the network. Different types of applications require different QoS, so the price will also be different according to the facility provided.

Corresponding author. Tel.: + 92-3337037187, +922449370435; fax: +922449370367.
E-mail address: sullemanmemonm@hotmail.com

2. Related Work

Very little work has been done in the field of MANETs on the pricing issue and mostly only algorithms are given in this regard by researchers. In [2] a numerical case study was presented by assuming price as a goal to simulate collaboration in MANETs. In this study it was illustrated that every node will arraign further nodes a fee for transmitting their traffic. In this research price was set by users to maximize their own net benefits. Authors also propose a iterative pricing algorithm that congregate sole resource provision to make best estimations about value but all was numerically demonstrated and most important QoS issue was completely absent from study.

In [3] an algorithm with pricing schemes was presented and QoS issue was discussed for different events of wireless networks and was expressed by Resource Utility Functions to maximize the aggregated utility of flows. Concave price wise utility function was presented in this research by Linear Programming Formulation (LPF) about the unrealistic solution of an optimal allocation problem by "Shadow Price Schemes" for resources. A very good work is presented by authors by designing an algorithm for on demand shortest path utility aware in which shadow prices are used on the basis of natural distance metrics comparing a non utility QoS approach. In all this work things on QoS are considered on the basis of routing and mobility but the traffic categories and their priorities are not considered so that one can give privilege to traffic according to their category for that they pay to network.

Omer Ileri and etc in [4] (at our best knowledge) first time give pricing algorithm that was designed for realistic commercial wireless ad hoc networks. Using microeconomic framework based on game theory, a pricing algorithm was designed for forwarding in autonomous nodes by reimbursing forwarding. The revenue maximization of network and utility maximization of nodes are measured in this research through pricing for channel use, forwarding, transmitter power control and destination preferences. It is proved by the authors through some simulations that pricing with reimbursement improves the network aggregate ability about utilities and revenue as compared to the network [5] with out reimbursement. Although it was a good work in the sense that authors introduces the pricing element for utilization of network facilities but resource reservation for that purpose and to provide QoS guarantee to customer if he pays price for that , is not addressed in this study.

BY keeping the dynamic nature of mobile ad hoc networks and to give incentive to the forwarding nodes for their relaying of information in [6] the authors introduces the new idea of payment on the basis of auction rules. By taking into consideration packet forwarding cost to the relay user a dynamic pricing frame work to maximize the sender's/receiver's payoff this idea was a brilliant progress in pricing section research of MANETs.

In [7] Authors initially model the pricing procedure according to dynamic nature of network and then pricing framework is proposed by enabling the sender to fully exploit the time diversity to increase his payoff by dynamically allocating packets to be transmitted into different stages. Simulation results show that optimal dynamic auction algorithm performs well in packet allocation and route selection procedures as compared to static pricing algorithms.

3. State of Art

In [8]authors gave entirely new and brilliant idea about a new gleaming approach with new pricing based resource distribution algorithm which is based on a methodical pricing pitch is purposely designed for the outstanding distinctiveness of multi-hop wireless and ad hoc networks .

The innovative participation incorporated in the pricing model, in fact, is the coalition of shadow prices having the maximal cliques in the contention graph model, to a certain extent; it deviates with the links in a wire line network. If the fact; that these technical trials have contributed to develop the insights, is accepted, the algorithms anticipated are copiously disseminated, and confer the contention surrounded with uninterrupted multi-hop flows when compared to blond resource allocation. The recurrently worn evenhandedness constraints, such as prejudiced proportional or max-min evenhandedness, may be straightforwardly supported by conveying their analogous effectiveness functions in this pricing model .The authority of our claims is supported by both theoretical studies and extensive simulation results.

In the presence of multi hop streams this work was an initial effort in which the problem of implementing egalitarianism was addressed to employ the pricing pitch in complete distributed environment

We feel that up to this stage no work has been performed in concerned with QoS issue in connection with pricing issues by considering different traffic categories and user's / client's approach of payment for the transmission of their contents on different priorities. This is a main issue required to be addressed now a days, especially in business environment and disaster management etc.

4. Routing and Resource Reservation

Our idea is to find more than one routes from source to destination was discussed in [9] and we propose to select three routes as Primary Path (PP), Secondary Path (SP) and Ternary Path (TP) as shown in Fig No:1. The traffic on the network is divided in to four categories according to their priorities as Very High Priority Traffic (VHPT), High Priority Traffic (HPT), Medium Priority Traffic (MPT) and Low Priority Traffic (LPT)/ (BET) as indicated in Fig No: 2.For reserving resources on paths certain policies will be employed as described in Table No1. Fig No. 2: indicates conceptual design for route selection and resource reservation on different routes to prioritized traffic. Continuing the work authors in [10] propose to offer Premium Service (PS), Gold Service (GS), Silver Service (SS) and Metal Service (MS) to the prioritized traffic according to above mentioned categories respectively.

With respect to transfer the contents, resources are required to be reserved along the selected path(s).In this regard previously two types of approaches are being used: load balancing in which multiple paths are selected and resources are reserved on those and packets are sent along all paths and other to use redundant paths but using only one at one time by reserving resources on that. On failure of first one, second is used and tried to reserve resources on that alternate path.

Then in [11] authors propose the premeditated policies to resource reservation for prioritized traffic in MANETs in the view of the QoS model presented in [12]. In [14] an algorithm was given to support this entirely new approach in which multiple paths are found and select best three from all those as primary, secondary and ternary on certain criteria of maximum bandwidth and minimum hops are selected. The paths must be loop free and node disjoined. Resources are reserved on both primary and secondary paths and allocate those reserved resources to different categories of traffic according to their priority on the basis of service agreement made with network. The authors designed the complete mechanism for allocating the resources to different priority traffics in which it is assumed that route break is predicted.

5. Hypothesis for Pricing Proposal

In continuation to the above work, we plan to suggest a pricing pitch for MANETs on the basis of traffic categories.

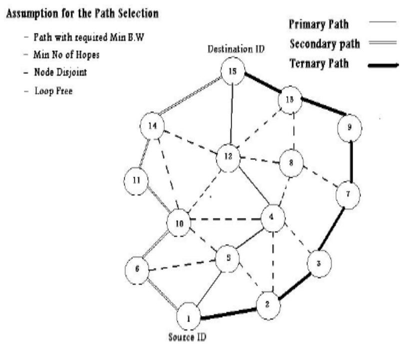

Fig. 1: Route selection criteria (node arrangement is taken by courtesy of [13])

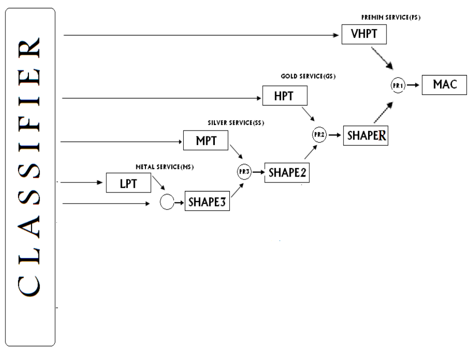

Fig.2: Classification of different traffics

This is a first approach in research, of its type in multi hop ad hoc networks. A lot of work has been performed on node incentive based transmission on data but here we are considering the business contents are required to be transferred. In this approach we suggest that the choice that how fast and when the contents are required to transmit depends on customer / user. As much user will pay to network, the system will provide that much higher facility to customer by allotting priority level to traffic according the contract. We have allocated priority levels 1, 2, 3 and4 to VHPT, HPT, MPT and BET respectively. Similarly network assume to give guarantee for transmit of contents to provide QoS in different ratios to different traffic categories. The price assumed for all this business is also suggested in units. Table No: 1 presents our idea of classification of traffic according to priority i.e. (type), optimized QoS after resource reservation in percentage i.e. (%) and Price to be paid by the customer for getting service from network in units i.e. (units).

6. Statistical Measurements

We measure our assumed values given in proposal by using Statistic Software Tool [15] on more than 15 different statistical attributes and find the very excellent results. All the assumed values are proportional to each other and are correctly fabricated in the measurements. Fig No: 3 shows the out put of all three entities in 3 dimensional form and linearity in graph indicates that all values are directly proportional. Attributes and their output statistical measurements are shown in Table No: 2.

Table. 1: Traffic priorities in ascending and descending order

No	Traffic (Type)	QoS (%)	Price (Units)
1	1 or 4	100	200
2	2 or 3	75	150
3	3 or 2	50	100
4	4 or 1	25	50

7. Verification for Validation of Pitch

The analysis is usually concerned with predicting one or more continuous variables with a set of inputs. This is specially done, when the target variables are continuous in nature. For the validation of above suggested pitch we decided to use a new (not used previously in MANETs) and one of the most and perhaps simplest approach of ANN i.e. MLP Model, which can contain a number of adjustable weights. Estimated model provide us best explanation of the data in hand. The mathematical function used to model such relationship is simply a linear transformation of two parameters, i.e. given by:

$$T= f(x) = a + bx \qquad (1)$$

In this model Logistics, Tanh and Identity are used as Hidden Activation of model and Tanh, identity and Exponential used Output activation variables of model for the network training purpose we use one input neuron, one hidden neuron and one output neuron in MLP model as MLP 1-1-1. The training was performed on 5 different algorithms of Quais-Newton as BFGS 43, BFGS 35, BFGS 39, BFGS 583 and BFGS 880 randomly and error functions are performed as Sum of Square Errors (SOS). The training performance of model is evident from the training errors that were minimized to 0.0002. BFGS is the second iteration model that is considered as powerful second order algorithm with very fast convergence. Table No:3 shows the statistics about active network results and in Fig No: 4 we have presented graph of three best results of training algorithm, which sows errors as 0.000101, 0.002656 and 0.00000.

8. Conclusion

Rather than designing and working on typical mathematical models and approaches for pricing in ad hoc networks for the broadcast of contents on node basis, in this paper we have tried to give a multi hop based pricing pitch. This is a first approach of this type in research. To look for its functionality we assume some theoretical data and perform some hypothetical measurements on that imaginary data. We find very excellent results when we run it on a simple model of ANN using only one neuron. Errors found in training of model are approximately near to zero. All this is tested on 5 different algorithms separately and it gave same validity on each iteration. We hope that these results will help in research to develop a practical bandwidth broker in future that can be used for transmission of contents in commercial production, emergencies, mission critical and broadcasting scenarios where real time transmission require guaranteed QoS.

9. Acknowledgment

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Table 2. Different attributes and their statistical results

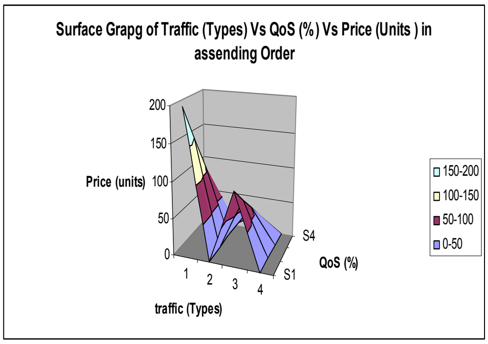
Variable	Descriptive Statistics							
	Valid N	% Valid obs.	Mean	Geometric	Harmonic	Median	Mode	Frequency
Traffic (Type)	4	40.00000	2.5000	2.2134	1.92000	2.5000	Multiple	1

Variable	Descriptive Statistics							
	Valid N	% Valid obs.	Mean	Geometric	Harmonic	Median	Mode	Frequency
QoS (%)	4	40.00000	62.5000	55.3341	48.00000	62.5000	Multiple	1
Price (units)	4	40.00000	125.0000	110.6682	96.00000	125.0000	Multiple	1

Variable	Descriptive Statistics							
	Sum	Minimum	Maximum	Lower	Upper	Variance	Std. Dev.	Coef. Var.
Traffic (Type)	10.0000	1.00000	4.0000	1.50000	3.5000	1.667	1.29099	51.63978
QoS (%)	250.0000	25.00000	100.0000	37.50000	87.5000	1041.667	32.27486	51.63978
Price (units)	500.0000	50.00000	200.0000	75.00000	175.0000	4166.667	64.54972	51.63978

Table . 3. Active Network Results of 5 BFGS algorithms showing testing errors

Summary of active networks							
Index	**Net. name**	**Training perf.**	**Training error**	**Training algorithm**	**Error function**	**Hidden activation**	**Output activation**
1	MLP 1-1-1	0.999384	0.000506	BFGS 23	SOS	Exponential	Logistic
2	MLP 1-1-1	0.999995	0.000004	BFGS 24	SOS	Logistic	Exponential
3	MLP 1-1-1	0.999675	0.000154	BFGS 43	SOS	Exponential	Logistic
4	MLP 1-1-1	0.999998	0.000002	BFGS 22	SOS	Identity	Exponential
5	MLP 1-1-1	0.979480	0.003744	BFGS 23	SOS	Tanh	Exponential



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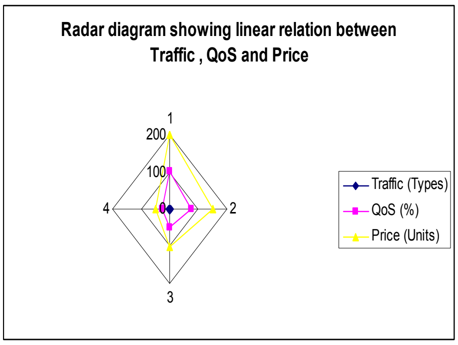
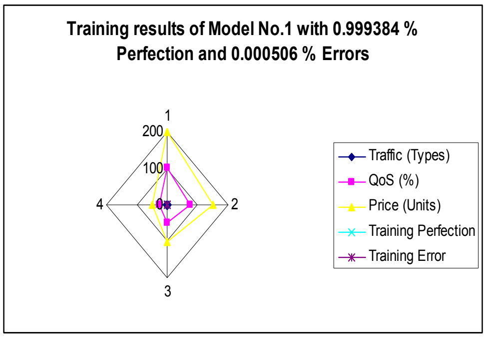


(b)

Fig:3. Two different graphs showing 3 Dimensional output of all values of 3 entities Traffic, QoS & Price



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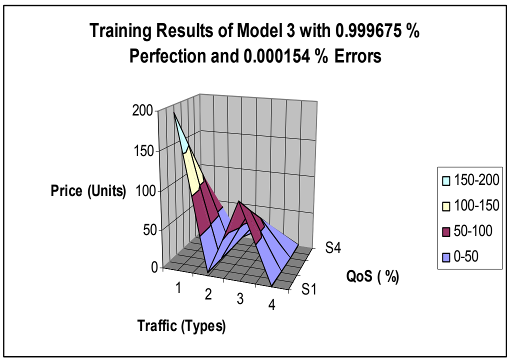

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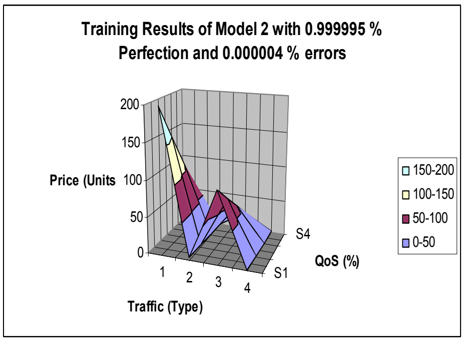

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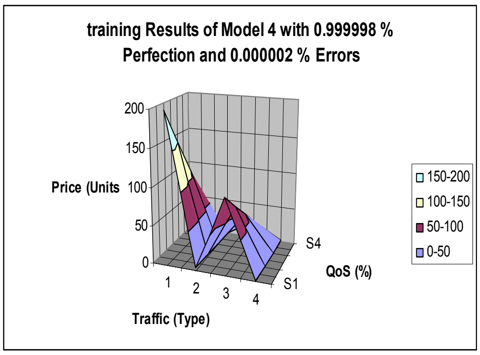

(d)

Fig. 4: 3D Graphs showing the 4 best results of testing Models