CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This research aimed to formulate new optimal pricing schemes in multiple class QoS networks. The current internet charging framework that relies on the flat rate charging scheme is not appropriate for telcos. The proposed model formulation for internet pricing in multiple class QoS networks provides a new idea for overcoming the customer's tendencies for flat rate internet pricing schemes.

The model formulations for internet pricing were analyzed by comparing all possible cases related to setting up of base prices and quality premium parameters occurring in the model to yield optimal pricing schemes under multiple class QoS networks. The first main model formulation for internet pricing schemes focuses on formulation of internet pricing in multiservice networks meanwhile the second main model formulation focuses on formulation of internet pricing in multiple class QoS networks.

After analyzing all the solutions for the model formulation for internet pricing schemes in multiple class QoS networks, the next process was to determinate whether the pricing schemes offer better pricing that gives an advantage to telcos.

This thesis was motivated by the problem of providing the right pricing for QoS networks. Hence, this study was determined to investigate the critical issue of internet pricing in QoS networks that exist due to the lack of information on how ISPs can set up the right pricing scheme to charge the users. Particular goals had been set to examine the improved model for internet pricing in multiple class QoS networks and multi service networks in order to obtain higher profits as previously discussed in past

researches. Both the focus and the goals of this study are described in Chapter 1. The previous background studies conducted by researchers are described in Chapter 2.

In Chapter 3, the method used to formulate the model formulation is presented. The parameters and decision variables had been determined to achieve the ISP's objective, which is to gain maximum profit by charging internet users. The parameters and decision variables had been chosen for each case related to internet pricing in multi service network and *multiple class QoS networks.*

The first contribution of this study is presented in Chapter 4. The original formulation proposed by previous researches for multi service networks were approached using the new method, which is by formulating the model for internet pricing into optimization problems, which are then solved by using the Branch and Bound method provided by the LINGO 13.0 software. The results of the improved model in multi service networks shows higher profits gained by the ISPs than in previous researches.

The second contribution is the new improved formulations for internet pricing in multi service networks was developed like stated in Eq (45) to Eq (59). The advantage of these improved formulations for internet pricing are the complete information we would gain regarding base price, quality premium, QoS level, number of users applying for the service and number of network shares in the service. This study produced better profit gains when solving the optimization problem of internet pricing in multi service networks compared to previous researches by Sain & Herpers (2003).

The next contribution as discussed in Chapter 4 is the improved formulation for internet pricing of multiple links in multi service networks like stated in Eq (60) to Eq(74). The new improved model formulation of internet pricing is developed as previously discussed. The usefulness of the improved model formulation is in the model's capability to handle more than a single link in the networks. The complete information in each link regarding the base price, the quality premium, the QoS level for each service, the number of users applying the service and the networks shared for each service were observed. The solutions for optimization problems in the internet pricing model formulation in multiple links resulted in maximum profits obtained by ISPs.

Chapter 5 highlights the second contribution towards internet pricing by networks in multiple class QoS networks. The fourth contribution will be the improved formulations of internet pricing schemes for single link in multiple class QoS networks which were developed by considering the base price, quality premium and QoS level per class like stated in proposed constraints (75) to Constraints (80). The model formulations were improved by setting up the value of the base price and quality premium to be fixed or to be varied. The results from these formulations can enhance the ISP's decision to achieve the goal of profit maximization. Our formulations have advantages regarding the availability of information on base price, quality premium and QoS level for each class in the network compared to previous researches on QoS networks.

The last contribution is by developing the new improved formulation of internet pricing schemes in multiple links in multiple class QoS networks like stated in Eq(81) to Eq (85). Since the actual QoS network has more than one link, thus, the network is developed by considering multiple bottleneck links in networks. Our proposed model formulation provides the information on how to maximize the ISP's profit margin with each value of decision variables and parameters that have been set up. The users are able to be assigned to certain classes with certain requirements, such as bandwidth availability.

6.2 Recommendations for Future Work

This study reveals that there many issues remaining that needs to be investigated. The effort to develop a realistic situation in actual networks is a critical situation in current issues pertaining to internet pricing. The economic point of view in providing multi service and multi class QoS network communication has not being completely discussed due to incomplete information on how to deal with that issue, especially regarding the goal of ISPs to maximize profit by disregarding the user's point of view.

Also, there are some limitations to the models. First, the models should be able to work in dynamical situation. It means that for some cases, the models only applicable for theoretical study. The assumptions of the model should be omitted. Since the study more focus on formulating the mathematical programming problem of MINLP be solved iteratively using LINGO that is why some assumptions should be performed to enable the MINLP works. It should be no upper and lower bound value of the additional constraints in order to solve the problem. So real dynamical situation can really works in the model proposed.

It is also interesting to develop new possibilities in dealing with internet pricing schemes in wireless or mobile networks. In this present era of technology, the wireless QoS network is a more challenging aspect for ISPs to develop. The willingness of ISPs to obtain maximum profit by developing internet pricing for the wireless network sector is also crucial in the coming years.