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SOLUTIONS OF INTERNET PRICING SCHEME BASED MULTI SERVICE MUTI LINK NETWORKS WITH VARIOUS REQUIREMENTS FOR THE BASE COST AND QUALITY PREMIUM

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ABSTRACT

In this paper, the improved model of wired internet on multi service multilink networks are proposed by varying base cost and varying and fixing quality premium. The previous research focused only on modeling the model without considering the variety of base cost and quality premium. So, in this paper, we seek to improve that models that fit to various condition of base cost and quality premium. The optimal solution of each case then is compared to previous research which only focused on limited number of services offered to maintain ISPs' goal in achieving the highest revenue. Using Lingo 11.0, the results show that the improved model using 4 services and 3 links, the network achieved highest optimal solution by varying the base price and fixing the quality premium. This model is considered to be the option for ISPs if ISPs intend to promote certain services while having competition in information service markets.

Keywords: multi service multilink network, base cost, quality premium, pricing scheme.

INTRODUCTION

ISPs have purpose to satisfy the users and maximize the advantage. Based on Puspita et al.(2013) and Sain and Herpers (2003), the optimal pricing scheme of internet is obtained by comparing QoS multilink bottleneck on multilink and multi service and then by adding the parameters and variables. Bottleneck is narrowing path that result in slow internet connection for large data accessed while the path provided is not able to accommodate the data accessed. Models that have been formed by Yang (2004), Yang et al., (2004; 2005; 2003) and Byun and Chatterjee (2004) are modified by forming a model with a base price (α) as variable and premium quality (β) as parameter or as variable to produce optimal solution.

Based on research conducted on the pricing schemes of wired network multi-service multi-link (Puspita et al., 2014; Puspita et al., 2014; Puspita et al., 2014) then this paper is to discuss the comparison of 4 service models and 2 links that will be compared with previous research proposed by previous authors, by using new data with 3 service and 2 links and then defined base price as variable that are expected to balance the conditions of the service provider in order not to loss. The purpose of the comparison to be observed is to obtain the best optimal results with defined base price as variable to ISP be able to compete in the market and promote certain services. Paper is expected to facilitate the ISP in selecting services that can maximize profits and allow users to choose the service according to their preferences.

METHODS

In this research we use Lingo 11.0 program to get optimal solution from non-linier equation. Models defined are based on parameters and variables that used to solve optimization problems. To analyze the case on multi service, we need the data. The data used in this study come from one of the local server in Palembang. The optimal solution can help in showing the existing problems involving pricing, service network, capacity and QoS levels.

MODELS

Models that used is based on Puspita et al. (2015) and with defined base price (α) as variables and quality premium (β) as variable or constant of 2 models for case 1, we have base price as variable and quality premium as variable for 27 sub cases and case 2 for base price as variable and quality premium as parameter for 9 sub cases.

RESULT AND DISCUSSION

To comlete the case we need to run LINGO.11.0 The model is Mixed Integer Nonlinear Programming which completed the iterations by using branch and bound solver.

Based on model Puspita et al. (2014; 2015) with *i*=1,2,3,4 , then we obtain as follows.
For case 1 (α and β variable)

$$Max\ R = \sum_{k=1}^{3}\sum_{i=1}^{4}(\alpha_i + \beta_i . I_i) . p_{ik} . x_{ik}$$

$$=(\alpha_1+\beta_1.I_1)3x_{11}+(\alpha_2+\beta_2.I_2)45x_{21}+(\alpha_3+\beta_3.I_3)15x_{31}+(\alpha_4+\beta_4.I_4)11x_{41}+$$
$$(\alpha_1+\beta_1)6x_{12}+(\alpha_2+\beta_2.I_2)21x_{22}+(\alpha_3+\beta_3.I_3)24x_{32}+(\alpha_4+\beta_4.I_4)18x_{42}+$$
$$(\alpha_1+\beta_1)9x_{13}+(\alpha_2+\beta_2.I_2)30x_{23}+(\alpha_3+\beta_3.I_3)26x_{33}+(\alpha_4+\beta_4.I_4)12x_{43}$$

With problem :

$5\ I_1 x_{11} \leq 838\ a_{11}$ (1)
$17\ I_2 x_{21} \leq 838\ a_{21}$ (2)
$815\ I_3 x_{31} \leq 838\ a_{31}$ (3)
$1 I_4 x_{41} \leq 838\ a_{41}$ (4)
$7\ I_1 x_{12} \leq 13.244\ a_{12}$ (5)
$75\ I_2 x_{22} \leq 13.244\ a_{22}$ (6)
$13.244\ I_3 x_{32} \leq 13.244\ a_{32}$ (7)
$1 I_4 x_{42} \leq 13.244\ a_{42}$ (8)
$5\ I_1 x_{13} \leq 7.922\ a_{13}$ (9)
$56\ I_2 x_{23} \leq 7.922\ a_{23}$ (10)
$7.861\ I_3 x_{33} \leq 7.922\ a_{33}$ (11)
$1 I_4 x_{43} \leq 7.922\ a_{43}$ (12)
$5\ I_1 x_{11} + 17\ I_2 x_{21} + 815\ I_3 x_{31} + 1 I_4 x_{41} \leq 838$ (13)
$7\ I_1 x_{12} + 75\ I_2 x_{22} + 13.244\ I_3 x_{32} + 1 I_4 x_{42} \leq 13.326$ (14)
$5\ I_1 x_{13} + 56\ I_2 x_{23} + 7.861\ I_3 x_{33} + 1 I_4 x_{43} \leq 7.922$ (15)
$a_{11} + a_{21} + a_{31} + a_{41} = 1$ (16)
$a_{12} + a_{22} + a_{32} + a_{42} = 1$ (17)
$a_{13} + a_{23} + a_{33} + a_{43} = 1$ (18)
$0 \leq a_{ij} \leq 1$ (19)
$0,01 \leq I_{1,2,3,4} \leq 1$ (20)
$0 \leq x_{ij} \leq 10$ (21)
$\{x_{11}, x_{21}, x_{31}, x_{41}, x_{12}, x_{22}, x_{32}, x_{42}, x_{13}, x_{23}, x_{33}, x_{43}\} \subseteq \mathbb{Z}^+$ (22)
$0,01 \leq \beta_{1,2,3,4} \leq 0,5$ (23)
$\alpha_i + \beta_i I_i \geq \alpha_{i-1}+\beta_{i-1} I_{i-1}$ (24)
$0 \leq \alpha_{1,2,3,4} \leq 1$ (25)
$I_i - I_{i-1} = 0$ (26)
$I_i - I_{i-1} > 0$ (27)
$I_i - I_{i-1} < 0$ (28)
$\beta_i - \beta_{i-1} = 0$ (29)

$$\beta_i - \beta_{i-1} > 0 \quad (30)$$
$$\beta_i - \beta_{i-1} < 0 \quad (31)$$
$$\alpha_i - \alpha_{i-1} = 0 \quad (32)$$
$$\alpha_i - \alpha_{i-1} > 0 \quad (33)$$
$$\alpha_i - \alpha_{i-1} < 0 \quad (34)$$

Case 2 (α variable dan β constant)

$$Max\ R = \sum_{k=1}^{3}\sum_{i=1}^{4}(\alpha_i + \beta_i . I_i). p_{ik} . x_{ik}$$
$$=(\alpha_1+\beta_1 . I_1)3x_{11}+ (\alpha_2+\beta_2 . I_2)45x_{21}+(\alpha_3+\beta_3 . I_3)15x_{31}+(\alpha_4+\beta_4 . I_4)11x_{41}+$$
$$(\alpha_1+ \beta_1)6x_{12}+(\alpha_2+\beta_2 . I_2)21x_{22}+(\alpha_3+\beta_3 . I_3)24x_{32}+(\alpha_4+\beta_4 . I_4)18x_{42}+$$
$$(\alpha_1+\beta_1)9x_{13}+(\alpha_2+\beta_2 . I_2)30x_{23}+(\alpha_3+\beta_3 . I_3)26x_{33}+(\alpha_4+\beta_4 . I_4)12x_{43}$$

With follow problems (1)-(22) and (25-27,31-33) and then add problem:

$$\alpha_i + I_i \geq \alpha_{i-1} + I_{i-1} \quad (24)$$

Applying LINGO 11.0, we have optimal solution from modified model. Optimal solution from cases show in Table 1 and Table 2:

Table 1 solution Model for Case 1 ($\alpha_i = \alpha_{i-1}, \beta_i = \beta_{i-1}, I_i > I_{i-1}$)

i	Total Capacity	Profit
1	15.3	106.2
2	133.2	566.4
3	19728	383.5
4	30	205
$\sum$	19906	1261.1

Table 2 Solution Model for Case 2($\alpha_i = \alpha_{i-1},\ \beta\ constant, I_i > I_{i-1}$)

i	Total Capacity	Profit
1	15.3	188.1
2	133.2	1003.2
3	19728	679.25
4	30	615
$\sum$	19906	2485.55

In Table 1 and 2, we can see that the higher total profit obtained when we set up based price as the variables and quality premium as the parameter with various condition of quality index which is greater than previous service.

Next in Table 3 and Table 4, we obtain the summary of our results for each case where we have four services and 3 links; 3 services and 3 links to be offered. The total capacity used for each case in Table 3 is achieved with the same value of 19,906.5 with different value of profit obtained. This difference is due to the setting up of the quality premium in order to meet the ISP s' goal to achieve the maximum profit. Again , for the different service offered, the Case 2 still reach the higher profit for ISP like stated in Table 4.

Table 3 Recapitulation Results of Case 1 and Case 2 for *i*=4 and *j*=3

	Case 1				Case 2			
	.α, β variable $I_i > I_{i-1}$				α variable,β parameter $I_i > I_{i-1}$			
	Service *i*							
i	1	2	3	4	1	2	3	4
Capacity used(%)	0.08	0.67	99.1	0.15	0.08	0.67	99.1	0.15
Total capacity	19,906.5				**19,906.5**			
Total capacity (%)	100				**100**			
Total income	1,261.1				**2,485.55**			

Table 4. Recapitulation Results of Case 1and Case 2 for *i*=3 *j*=2

	Case 1			Case 2		
	.α,β variable $I_i > I_{i-1}$			α variable,β constant $I_i = I_{i-1}$		
	Service *i*					
	1	2	3	1	2	3
i	9.1	0.01	90	90	8.1	0.6
Capacity used(%)	3.097,94			**3.080**		
Total capacity	100			**98.7**		
Total capacity (%)	1,045.2			**1,710**		

So, after all, with varied base price, ISP will get maximize income not only to ISP but also to user. Then ISP can choose other condition, and the users are given choice to choose service which their want in accordance with the budget that users have and ISP can promote a particular service to get maximum profit.

CONCLUSION

Optimal solution is case 2 model with α variable and β constant case and $I_i > I_{i-1}$ which mean internet service provider can vary base price and defined premium quality in terms of the index of the quality of service in the beginning so service provider can compete in the market and allows users to choose the service that suits users' needs so that there is continuity between the providers and users in utilization of the internet.

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