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M. I. Jambak ; H. Ahmad ; M. A. H. Mohammed ; S. A. Jumaat ; M. A. B. Sidik

Publication Year: 2017, Page(s): 321 - 327

Abstract (631 Kb)

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Modelling and optimization of simultaneous AC-DC transmission to enhance power transfer capacity of the existing transmission lines

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Improved Bundle Pricing Model On Wireless Internet Pricing Scheme In Serving Multiple QoS Network Based On Quasi-Linear Utility Function

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***Abstract*— In this paper, an improved Bundle Pricing model was developed in the internet wireless pricing scheme to serve multiple QoS networks. The model formed is a combination of Bundling problem model, consumer problem and quasi-linear utility function on multiple QoS network. The model used is solved with the aid of LINGO 13.0 program to get optimal solution. Based on the results of each case, both ISP and internet users get maximum benefit when ISP applies the model with utility function and QoS attribute compared to original model. The optimal solution is in the BER attribute QoS with a value of 3.04×10^8 on a flat fee and two-part tariff internet pricing scheme.**

Keywords—improved bundle pricing; utility function; multiple QoS network; QoS attribute; pricing scheme

I. Introduction

The use of the internet is almost inseparable from the public, so among the internet community, it is very important. As a result, the quality of internet services is required to be improved. Better quality of service or Quality of Service (QoS) to serve users in achieving the best information quality and maximizing profits is expected to be provided by internet service providers (ISPs) [1]. QoS attribute is divided into three namely, Bandwidth, End to End Delay and BER (bit error rate).

Some research discussed previously [1-3] and continued research by [4-9] and [10, 11] discusses the model for internet services based on different quality levels by loading on different schemes associated with QoS networks and multi-service networks. One Global economic problem is internet pricing, as ISP is currently in a state of high demand for providing information of good quality. In order to benefit ISPs, consumers are required to provide appropriate internet pricing schemes. Bundle pricing is one strategy that can be conducted by ISPs to minimize costs and maximize profits [12]. The utility function relates to the level of satisfaction consumers have available for the consumption of information services that maximize profits to achieve a particular objective [13].

Some critical issues have been discussed mainly on pricing schemes based on level of QoS in different allocations that would control the congestion and load balance [14] and the user sensitivity ability in network through user's utility probability in forms of packet loss, average packet delay, packet tail, maximum packet delay and also throughput [15]. Other form of pricing scheme is based on the function of time strategy [16]. Other strategy that can also be considered is dynamic pricing scheme which have considered the model as partial differential equations computed numerically.

Bundle pricing is a marketing practice in which two or more different products are put together in one package; this strategy extends across the market in various forms; in the past decade, bundle prices have grown in product marketing[17]. Bundle Pricing is considered to overcome the uncertainty of consumers to the product information services offered and to overcome the diversity of consumer types and have a good assessment of consumers [18].

To that end, the development of research for bundling strategies and the bundle of information product prices is one of the ISP's much-needed issues. Factors affect in the completion of the bundling model. Enhanced bundling strategy will be developed which is expected in the future can be used as a tool for achieving the ISPs' objective. Preliminary results discussed by [4], [19, 20] indicate that MINLP's refinement scheme on the bundle pricing strategy is proved to be better than a bundle pricing scheme with no function Utilities.

With such preliminary results, we attempt to develop a generalized MINLP enhanced model for consumer and service in wired networks that are in the current Internet era. It needs to be tackled because this issue includes critical issues that need to be searched.

Based on previous research on wireless internet pricing scheme on QoS [21-23], bundle pricing on internet pricing scheme[4, 20], this study discuss the increase of package price in wireless internet utilizing bandwidth function in serving multiple QoS networks.

II. Research Method

In this paper, the internet pricing scheme is solved by LINGO 13.0 program that is in form of non-linear optimization problems to get optimal solution. Models are formed based on the parameters and variables used to solve the optimization problem. Data required for the model is from the local server data to analyze the scheme based on multiple QoS networks. To analyze the case on the quasi-linear utility function, the usage data is required for peak hours and non-peak hours. The solutions obtained help to determine the optimal pricing on internet pricing on wireless bundle pricing modeling scheme in multiple QoS networks for internet pricing schemes based on quasi-linear utility functions.

III. RESULT AND DISCUSSIONS

In this section, original model proposed previously [12] is described along with our proposed improved model by considering quasi linear utility function and varying the base cost and quality premium.

A. *Bundling Original Model*

Optimization Model for Provider

$$\text{Max } R = \sum_{i=1}^{I}\sum_{j=1}^{J}(P_j - B_j)X_{ij} - \sum_{j=1}^{J} MY_j \quad (1)$$

Subject to set of Constraints (1.1):

$$S_i \geq (R_{ij} - P_j)Y_j, \quad i = 1, \dots, I; j = 1, \dots, J$$

$$S_i = \sum_{j=1}^{J}(R_{ij} - P_j)X_{ij}, \quad i = 1, \dots, I$$

$$(R_{ij} - P_j)X_{ij} \geq 0, \quad i = 1,.,I; j = 1,,J$$

$$\sum_{j=1}^{J} X_{ij} \leq 1, \quad i = 1, \dots, I$$

$$X_{ij} \leq Y_j, \quad i = 1, \dots, I; j = 1, \dots, J$$

$$S_i \geq 0, i = 1, \dots, I$$

$$P_j \geq 0, j = 1, \dots, J$$

$$X_{ij} = 0 \text{ or } 1$$

$$Y_j = 0 \text{ or } 1$$

Optimization of consumer issues

$$\text{Max } \theta = U_{i(X_i,Y_i)} - P_X X_i - P_Y Y_i - PZ_i \quad (2)$$

Subject to Constraints (2.1):

$$X_i \leq \bar{X}_i Z_i$$

$$Y_i \leq \bar{Y}_i Z_i$$

$$U_{i(X_i,Y_i)} - P_X X_i - P_Y Y_i - PZ_i \geq 0$$

$$Z_i = 0 \text{ or } 1$$

B. *Wireless Pricing Scheme based on Quasi-Linear Utility Function*

According to [24], a general form of utility function based on quasi linear is as follows.

$$U(X, Y) = aX + f(Y)$$

with *f(Y)* is a non-linear function and *a* is a constant. Nonlinear function used in this research is $f(Y) = Y^b$ with *b* is a constant.

The objective function is to maximize

$$\sum_j^m \sum_i^n (PR_{ij} \pm PQ_{ij} + \alpha_j Z_{ij} + W_j \log \frac{\tilde{X}_{ij}}{L_{m_j}}) \quad (3)$$

With set of Constraints (3.1):

$$PQ_{ij} = \left(1 \pm \frac{x}{Q_{bij}}\right) PB_{ij} Lx$$

Followed by the following Constraints (3.2):

$$PB_{ij} = a_{ij}(e - e^{-xB})T_l/100$$

$$L_x = a(e - e^{-xB}) \quad f \leq a_{ij} \leq g$$

$$h \leq T_l \leq k$$

$$0 \leq x \leq 1$$

$$0.8 \leq B \leq 1.07$$

$$a = 1$$

$$\sum_{j=1}^{2}\sum_i \tilde{X}_{ij} \leq Q, i = 1, \dots, n$$

$$\tilde{X}_{ij} \geq L_{m_j} - (1 - Z_{ij}), i = 1, \dots, n; j = 1, 2, \dots$$

$$W_j \leq W_{ij} + (1 - Z_{ij}), i = 1, \dots, n; j = 1, 2, \dots$$

$$\tilde{X}_{ij} \geq V_i - (1 - Z_{ij}), i = 1, \dots, n; j = 1, 2, \dots$$

$$\tilde{X}_{ij} \geq X_j - (1 - Z_{ij}), i = 1, \dots, n; j = 1, 2,$$

$$\tilde{X}_{ij} \geq Z_{ij}, \quad i = 1, \dots, n; j = 1, 2, \dots$$

$$\tilde{X}_{ij} \geq 0, i = 1, \dots, n; j = 1, 2, \dots$$

$$L_{m_j} \geq 0.01, j = 1, 2, \dots$$

$$W_j \geq 0, j = 1, 2, \dots$$

$$\tilde{X}_{ij} \leq X_j, \quad i = 1, \dots, n; j = 1, 2, ..$$

$$Z_{ij} = 0 \text{ or } 1$$

The maximum value for the end-to-end QoS attribute is 350Kbps, and for the QoS attribute BER (Bit Error Rate) is depending on the type of traffic[25].

In this research, 4 cases are discussed in the model in each QoS attribute. F each case, the objective function will change depending on the case of each. Cases to be discussed are as follows.

1. Case 1(PQ_{ij} increase, *x* increase)

Its objective function is to maximize:

$$\sum_j^m \sum_i^n (PR_{ij} + PQ_{ij} + \alpha_j Z_{ij} + W_j \log \frac{\tilde{X}_{ij}}{L_{m_j}})$$

With constraints:

$$PQ_{ij} = \left(1 + \frac{x}{Q_{bij}}\right) PB_{ij} Lx$$

This is followed by constraint (3.2).

2. Case 2 (PQ_{ij}increase, *x* decrease).

Its objective function is to maximize:

$$\sum_j^m \sum_i^n (PR_{ij} + PQ_{ij} + \alpha_j Z_{ij} + W_j \log \frac{\tilde{X}_{ij}}{L_{m_j}})$$

With constraints:

$$PQ_{ij} = \left(1 - \frac{x}{Q_{bij}}\right) PB_{ij} Lx$$

This is followed by Constraint (3.2).

3. Case 3 (PQ_{ij} decrease, *x* increase)

Its objective function is to maximize:

$$\sum_j^m \sum_i^n (PR_{ij} - PQ_{ij} + \alpha_j Z_{ij} + W_j \log \frac{\tilde{X}_{ij}}{L_{m_j}})$$

With constraints:

$$PQ_{ij} = \left(1 + \frac{x}{Q_{bij}}\right) PB_{ij} Lx$$

This is followed by Constraint (3.2).

4. Case 4 (PQ_{ij} decrease, x decrease)

Its objective function is to maximize:

$$\sum_{j}^{m}\sum_{i}^{n}(PR_{ij} - PQ_{ij} + \alpha_j Z_{ij} + W_j \log \frac{\tilde{X}_{ij}}{L_{m_j}})$$

With constraints:

$$PQ_{ij} = \left(1 - \frac{x}{Q_{bij}}\right) PB_{ij} Lx$$

This is followed by Constraint (3.2).

C. Bundling Improved Model

Based on Eq. (1), (2), and (3) then it is obtained the objective function as follows.

$$\text{Max } R = \sum_{i=1}^{I}\sum_{j=1}^{J}(P_j - B_j) X_{ij} - \sum_{j=1}^{J} MY_j - X^a Y^b + P_x X + P_y + PZ + \sum_{j=1}^{m}\sum_{i=1}^{n}\left(PR_{ij} \pm PQ_{ij} + \alpha_j Z_{ij} + w_j log \frac{\tilde{X}_{ij}}{L_{m_j}}\right)$$

Subject to the Constraints (1.1), (2.1), (3.1) and (3.2).

Table I depicts the traffic data observed from server local at Palembang. Table II explains the parameter used for the models.

TABLE I. INTERNET USAGE DATA AT PEAK AND NON PEAK HOURS

	Digilib(byte)	*Digilib*(kbps)
$\bar{X}$	55,013	53.2
$\bar{X}_2$	33,817	33.02
X_m	10,537	10.29
$\bar{Y}$	60,998	59.57
$\bar{\bar{Y}}_2$	47,829	46.71
Y_m	7,217	7.05

Table III-V show the decision variables, parameter used for homogenous and heterogeneous consumers, based on the data obtained from the local server and the predetermined numbers set up by the research, respectively.

TABLE II. PARAMETERS FOR EACH IMPROVED MODEL

Symbol	Definition
PR_{ij}	The specified linear parameter
a	Fees for connecting with available QoS (Rupiah)
Q_{bij}	The nominal value of the QoS attribute in network (kbps)
f	The minimum value that the service provider has set for a_{ij}
g	The maximum value that the service provider has set for a_{ij}
h	Minimum number of payload allowed for *Tl* (*kbps*)
k	Maximum number of payloads allowed for *Tl* (*kbps*) T_l
α_j	The base price for class j (rupiah)
Q	Total *bandwidth* (*kbps)*
V_i	The minimum bandwidth required by user *i*
B_j	The cost of making a bundle for each service *j*.
I	The number of potential customers as a marketing target.
J	The number of services provided by the service provider.
M	Marginal cost if adding more than one bundle service in the menu.
V_{ik}	The price of the *i*-th customer's order for each of *k*-favorite services.
R_{ij}	The total order price for each *i*-th customer on each favorite service to *k*.
P	Cost to be paid by consumers to subscribe the service.
P_X	The unit price set by the service provider during peak hours.
P_Y	The unit price specified by the service provider on the clock is not busy.
$U_{i(X_i,Y_i)}$	The consumer utility function *i* for the rush hour and clock rate is not busy

TABLE III. DECISION VARIABLES FOR EACH IMPROVED MODEL

Symbol	Definition
P_j	The price set for each *bundle* of services *j*.
S_i	Benefit usage for -*i* customer
X_{ij}	$\begin{cases}1, & \text{if consumer } i \text{ selects bundle in service } j\\ 0, & \text{if consumer } i \text{ does not select bundle in service } j\end{cases}$
Y_j	$\begin{cases}1, & \text{if the service provider offers a } bundle \text{ of services } j\\ 0, & \text{if the service provider does not offer a } bundle \text{ of services } j\end{cases}$
X_i	Consumer consumption level *i* on busy hour service.
Y_i	Consumer consumption level *i* on clock service is not busy.
Z_i	$\begin{cases}1, & \text{if customer } i \text{ chose to join with program}\\ 0, & \text{if customer } i \text{ did not choose join program}\end{cases}$
$\bar{X}_i$	The consumer's maximum consumption level *i* on the peak hour
$\bar{Y}_i$	The consumer's maximum consumption rate *i* on non-peak hour
PQ_{ij}	Cost change as long as QoS changes (Rupiah)
PB_{ij}	Basic cost for a connection with user *i* and class *j*
Lx	Linearity factor
a_{ij}	Linear cost factor in user *i* and class *j*
T_l	Traffic load
x	Number of increase or decrease in QoS value
B	The specified linear parameter
Z_{ij}	$\begin{cases}1, & \text{if user i is in class j}\\ 0, & \text{user i is not in class j}\end{cases}$
W_j	Price sensitivity for class *j*
$\tilde{X}_{ij}$	The final bandwidth obtained by user *i* for class *j*
L_{mj}	Minimum bandwidth for class *j*
W_{ij}	Price sensitivity of user *i* in class *j*
X_j	Bandwidth for each individual in class *j*

TABLE IV. PARAMETER VALUE FOR HOMOGEN CONSUMERS

Parameter	**Value**		
	Flat fee	**Usage based**	**Two-Part tariff**
V_{11}	500	500	500
V_{12}	800	800	800
V_{21}	600	600	600
V_{22}	900	900	900
M	200	200	200
B_1	300	300	300
B_2	500	500	500
a	3	3	3
b	4	4	4
$\bar{X}$	53.72	53.72	53.72
$\bar{Y}$	59.57	59.57	59.57

TABLE V. PARAMETER VALUE FOR HETEROGENEOUS CONSUMERS

Parameter	**Value**		
	Flat fee	**Usage based**	**Two-Part tariff**
V_{11}	500	500	500
V_{12}	800	800	800
V_{21}	600	600	600
V_{22}	900	900	900
M	200	200	200
B_1	300	300	300
B_2	500	500	500
a_1	3	3	3
a_2	3	3	3
b_1	2	2	2
b_2	2	2	2
$\bar{X}_1$	53.72	53.72	53.72
$\bar{X}_2$	33.02	33.02	33.02
$\bar{Y}_1$	59.57	59.57	59.57
$\bar{Y}_2$	46.71	46.71	46.71

To solve the case, Lingo 13.0 program is required. The model formed is a Mixed Integer Nonlinear Programming model that is solved interatively using Branch and Bound Solver.

TABLE VI. ORIGINAL MODEL SOLUTION FOR END-TO END DELAY QOS ATTRIBUTE

Solver Status	**Case**			
	PQ_{ij} increase x increase	**PQ_{ij} increase x decrease**	**PQ_{ij} decrease x increase**	**PQ_{ij} decrease x decrease**
Model Class	MINLP	MINLP	MINLP	MINLP
State	Local Optimal	Local Optimal	Local Optimal	Local Optimal
Objective	632.743	632.569	601.806	601.806
Infeasibility	0.00048753	0.00048753	0.00013577	0.00013577
Iterations	54	55	54	54
Extended Solver Status				
Solver Status	Branch and Bound	Branch and Bound	Branch and Bound	Branch and Bound
Best Objective	632.743	632.569	601.806	601.806
Steps	1	1	1	1
Update Interval	2	2	2	2
GMU (K)	34	34	34	34
ER (Sec)	0	0	1	0

TABLE VII. ORIGINAL SOLVER STATUS FOR BER QOS ATTRIBUTE

Solver Status	**Case**			
	PQ_{ij} increase x increase	**PQ_{ij} increase x decrease**	**PQ_{ij} decrease x increase**	**PQ_{ij} decrease x decrease**
Model Class	MINLP	MINLP	MINLP	MINLP
State	Local Optimal	Local Optimal	Local Optimal	Local Optimal
Objective	3×10^8	618.133	601.821	602.19
Infeasibility	4.1×10^{-12}	0.00048743	0.00024892	7.7×10^8
Iterations	50	52	56	45
Extended Solver Status				
Solver Status	Branch and Bound	Branch and Bound	Branch and Bound	Branch and Bound
Best Objective	3×10^8	618.133	601.821	602.19
Steps	1	1	1	1
Update Interval	2	2	2	2
GMU (K)	34	34	34	34
ER (Sec)	1	0	1	1

Table VI-VII show the solution of the original model with end-to-end delay and BER QoS attributes, where the optimal solution is found in the original model with the BER attribute QoS. Table VIII-IX show the solution for End to End Delay and BER QoS Attributes for each homogeneous and heterogeneous consumers, respectively. For end-to end delay QoS attribute, optimal iterations are found in the flat fee pricing scheme.

Table X-XI show an improved model solution with quasi-linear utility functions for heterogeneous consumers. For QoS attribute end-to-end delay and QoS Attribute The optimal iteration BER is in the two-part tariff pricing scheme.

TABLE VIII. WIRELESS IMPROVED MODEL SOLUTIONS WITH END-TO END DELAY QOS ATTRIBUTE FOR HOMOGENEOUS CONSUMERS

Solver Status	**Case**			
	PQ_{ij} increase x increase	**PQ_{ij} increase x decrease**	**PQ_{ij} decrease x increase**	**PQ_{ij} decrease x decrease**
Model Class	MINLP	MINLP	MINLP	MINLP
State	Local Optimal	Local Optimal	Local Optimal	Local Optimal
Objective	633.34	633.16	633.34	633.169
Infeasibility	0.0001143	0.00011435	0.00011435	0.000114354
Iterations	87	89	87	89
Extended Solver Status				
Solver Status	Branch and Bound	Branch and Bound	Branch and Bound	Branch and Bound
Best Objective	633.34	633.16	633.34	633.169
Steps	1	1	1	1
Update Interval	2	2	2	2
GMU (K)	47	47	47	47
ER (Sec)	0	0	0	1

TABLE IX. MODEL IMPROVED WIRELESS SOLUTIONS WITH BER FOR HOMOGENEOUS CONSUMERS QOS ATTRIBUTE

Solver Status	**Case**			
	PQ_{ij} **increase** x **increase**	PQ_{ij} **increase** x **decrease**	PQ_{ij} **decrease** x **increase**	PQ_{ij} **decrease** x **decrease**
Model Class	MINLP	MINLP	MINLP	MINLP
State	Local Optimal	Local Optimal	Local Optimal	Local Optimal
Objective	3.04×10^8	618.733	3.04×10^8	618.733
Infeasibility	5.1×10^{-7}	0.0001143	5.14×10^{-7}	0.00011435
Iterations	62	87	62	87
Extended Solver Status				
Solver Status	Branch and Bound	Branch and Bound	Branch and Bound	Branch and Bound
Best Objective	3.04×10^8	618.733	3.04×10^8	618.733
Steps	0	1	0	1
Update Interval	2	2	2	2
GMU (K)	47	47	47	47
ER (Sec)	1	1	1	0

Based on Table VI-XI, it can be observed that through the improved models for homogeneous and heterogeneous consumers, ISPs are able to obtain higher profit rather that only applying the original model without any utilization of utility function. As the meaning of the utility function, it has greater impact in deciding the willingness to pay of the consumer.

TABLE X. MODEL IMPROVED WIRELESS SOLUTIONS WITH QOS ATTRIBUTE END-TO END DELAY FOR HETEROGENEOUS CONSUMERS

Solver Status	**Case**			
	PQ_{ij} **increase** x **increase**	PQ_{ij} **increase** x **decrease**	PQ_{ij} **decrease** x **increase**	PQ_{ij} **decrease** x **decrease**
Model Class	MINLP	MINLP	MINLP	MINLP
State	Local Optimal	Local Optimal	Local Optimal	Local Optimal
Objective	633.343	633.169	633.343	633.169
Infeasibility	0.0001143	0.00011435	0.00011435	0.000114353
Iterations	92	90	92	90
Extended Solver Status				
Solver Status	Branch and Bound	Branch and Bound	Branch and Bound	Branch and Bound
Best Objective	633.343	633.169	633.343	633.169
Steps	1	1	1	1
Update Interval	2	2	2	2
GMU (K)	49	49	49	49
ER (Sec)	1	0	0	1

TABLE XI. MODEL IMPROVED WIRELESS SOLUTIONS WITH QOS ATTRIBUTE BER FOR HETEROGENEOUS CONSUMERS

Solver Status	**Case**			
	PQ_{ij} **increase** x **increase**	PQ_{ij} **increase** x **decrease**	PQ_{ij} **decrease** x **increase**	PQ_{ij} **decrease** x **decrease**
Model Class	MINLP	MINLP	MINLP	MINLP
State	Local Optimal	Local Optimal	Local Optimal	Local Optimal
Objective	3.04×10^8	618.733	3.04×10^8	618.733
Infeasibility	5.1×10^{-7}	7.9×10^{-6}	5.1×10^{-7}	7.9×10^{-6}
Iterations	62	88	62	88
Extended Solver Status				
Solver Status	Branch and Bound	Branch and Bound	Branch and Bound	Branch and Bound
Best Objective	3.04×10^8	618.733	3.04×10^8	618.733
Steps	0	1	0	1
Update Interval	2	2	2	2
GMU (K)	49	49	49	49
ER (Sec)	0	1	0	0

IV. CONCLUSION

Based on wireless bundle pricing modeling in multiple QoS networks based on Quasi-Linear Utility Functions discussed in this paper, a more optimal solution is found in the models with utility functions compared to the original model. The optimal solution is in the BER attribute QoS with a value of 3.04×10^8 on a flat fee and two-part tariff internet pricing scheme.

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REFERENCES

[1] J. Byun and S. Chatterjee, "A strategic pricing for quality of service (QoS) network business", in Proceedings of the Tenth Americas Conference on Information Systems, 2004, New York.

[2] S. Sain and S. Herpers, "Profit Maximisation in Multi Service Networks-An Optimisation Model", in Proceedings of the 11th European Conference on Information Systems ECIS 2003, 2003, Naples, Italy

[3] W. Yang, Pricing Network Resources in Differentiated Service Networks, in School of electrical and Computer Engineering. 2004, Phd Thesis, Georgia Institute of Technology. p. 1-111.

[4] F.M. Puspita, and M. Ulfa, "The New Approach of Bundle-Pricing Scheme Models by Using Branch and Bound Solver", in Indonesia-Malaysia Symposium on South East Asia Studies, Jakarta. 2016: Universitas Trilogi, Jakarta, Indonesia.

[5] F. M. Puspita, K. Seman, B. M. Taib and Z. Shafii, "Improved Models of Internet Charging Scheme of Single Bottleneck Link in Multi QoS Networks", Journal of Applied Sciences, 2013, 13(4): p. 572-579.

[6] F. M. Puspita, K. Seman, B. M. Taib and Z. Shafii, "Improved Models of Internet Charging Scheme of Multi bottleneck Links in Multi QoS Networks", Australian Journal of Basic and Applied Sciences, 2013, **7**(7): p. 928-937.

[7] Irmeilyana, Indrawati, F. M. Puspita and L. Herdayana, "The New Improved Models of Single Link Internet Pricing Scheme in Multiple QoS Network", in International Conference Recent treads in Engineering & Technology (ICRET'2014), Batam (Indonesia). 2014.

[8] Irmeilyana, Indrawati, F. M. Puspita and L. Herdayana," Improving the Models of Internet Charging in Single Link Multiple Class QoS Networks", in 2014 International Conference on Computer and Communication Engineering (ICOCOE'2014) 2014, Melaka, Malaysia.

[9] Irmeilyana, Indrawati, F. M. Puspita and L. Herdayana, "Improving the Models of Internet Charging in Single Link Multiple Class QoS Networks," in Advanced Computer and Communication Engineering Technology, H.A. Sulaiman, et al., Editors. 2015, Springer Publishing International: Switzerland.

[10] Indrawati, Irmeilyana, F. M.Puspita and M. P. Lestari, "Cobb-Douglass Utility Function in Optimizing the Internet Pricing Scheme Model", TELKOMNIKA, 2014. 12(1).

[11] Indrawati, F. M. Puspita, Irmeilyana, and O. Sanjaya, "Pembiayaan Internet Menggunakan Fungsi Utilitas Cobb-Douglas", in Seminar dan Rapat Tahunan Bidang MIPA, Universitas Tanjung Pura, Pontianak Kalimantan Barat, 2015: Universitas Tanjung Pura, Pontianak Kalimantan Barat.

[12] S. Viswanathan and G. Anandalingam, "Pricing strategies for information goods", Sadhana 2005. 30(April/June 2005): p. 257-274.

[13] X.Wang and H. Schulzrinne, "Pricing network resources for adaptive applications in a differentiated services network", in Proceedings of IEEE INFOCOM 2001. 2001. Anchorage, AK, April 2001.

[14] C. Gu, , S. Zhuang, and Y. Sun, "Pricing incentive mechanism based on multistages traffic classification methodology for QoS-enabled networks", Journal of Networks, 2011. 6(1): p. 163-171.

[15] H. Gottinger, "Network economies for the internet-application models", iBusiness, 2011. 3: p. 313-322.

[16] E. Safari, , M. Babakhani, , S. J. Sadjadi, K. Shahanaghi and K. Naboureh, "Determining strategy of pricing for a web service with different QoS levels and reservation level constraint", Applied Mathematical Modelling, 2014.

[17] S. Stremersch, and G. Tellis, "Strategic Bundling of Products and prices:A New Synthesis for Marketing", J.Marketing 2002, 66(January): p. 55-72.

[18] S.-y.Wu, L. M. Hitt, P.-y. Chen and G. Anandalingam, "Customized Bundle Pricing for Information Goods: A Nonlinear Mixed-Integer Programming Approach", Management Science 2008, 54(3): p. 608-622.

[19] F.M. Puspita, Irmeilyana, and R.R.O. Ringkisa, "Pemodelan Bundle Pricing dengan Fungsi Utilitas Bandwidth pada Tiga Strategi Pembiayaan Internet", in Seminar dan Rapat Tahunan 2016 Bidang MIPA BKS-PTN Barat Universitas Sriwijaya. 2016: Palembang.

[20] F.M.Puspita, E. Yuliza, and M. Ulfa, "The Comparison of Bundle-Pricing Scheme Models Using Quasi-Linear Utility Function", in International Conference on Science, Technology, Interdisciplinary Research 2016, University of Lampung.

[21] Irmeilyana, F.M. Puspita, and I. Husniah, "Analisis Skema Pembiayaan Internet Jaringan Wireless dalam Penetapan Strategi Pembiayaan Internet Penyedia Layanan Internet (ISP)", in Annual Research Seminar (ARS) 2015, 2015, Palembang, South Sumatera, Indonesia: Lembaga Penelitian dan Pengabdian Masyarakat (LPPM) Fakultas Ilmu Komputer Bekerjasama dengan UPT. Penerbit dan Percetakan Unsri.

[22] Irmeilyana, F.M. Puspita, and I. Husniah, "Optimization of Wireless Internet Pricing Scheme in Serving Multi QoS Network Using Various QoS Attributes", TELKOMNIKA, Telecommunication, Computing, Electronics and Control, 2016, 14(1).

[23] Irmeilyana, F.M. Puspita, and Indrawati, "Skema Pembiayaan Internet Wireless dalam Melayani Jaringan Multi QoS", in Seminar dan Rapat Tahunan Bidang MIPA, Universitas Tanjung Pura, Pontianak Kalimantan Barat, 2015: Universitas Tanjung Pura, Pontianak Kalimantan Barat.

[24] E. Hutchinson, Economics. 2011.

[25] E. Wallenius, and T. Hämäläinen, "Pricing Model for 3G/4G Networks", in The 13th IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications, 2002: Lisbon, Portugal.

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