行政院國家科學委員會專題研究計畫 成果報告

雙網環境下藉由價格機制改善服務品質與提高廠商收益之研究

研究成果報告(精簡版)

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行政院國家科學委員會補助專題研究計畫
成果報告

雙網環境下藉由價格機制改善服務品質與提高廠商收益之研究

A Pricing-Based Approach to Improve QoS and Increase Provider Revenue in UMTS/WLAN Network

計畫類別：個別型計畫
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(I) 中文摘要

在未來異質網路的整合環境中，QoS (Quality of Service)的問題益形重要，而以現今的網路環境而言，最有可能是整合UMTS與WLAN的異質網路。在本計畫中，我們將以UMTS與WLAN的異質網路整合環境作為基礎，提出Pricing-Improved QoS的觀念，結合Non usage-based pricing、Usage-based pricing、Static pricing和Dynamic pricing的優點；利用DiffServ (Differentiated Services)機制劃分服務等級(service level)，實際設計出使用者效用函數(utility function)與網路成本函數(cost function)，並以第三級差別取價(Third-Degree Price Discrimination)與兩段訂價法(Two-Part Tariff)訂定價格。藉著價格機能(pricing)，讓使用者表達其對服務等級的需求或期望，並使網路資源適當地分配給各種服務，避免資源浪費或錯置的情形，以滿足QoS的需求並提高整體社會福利及增加廠商收益(provider revenue)。末了，我們將根據Voice over IP、Video Phone、Video Streaming、FTP四種訊務模型，在以DiffServ為基礎的UMTS/WLAN網路架構下，利用模擬系統

- 計算各服務等級的最佳使用者人數
- 驗證各服務等級的頻寬配置是否合適
- 驗證各服務等級的QoS要求是否能被滿足
- 驗證是否能有效提升廠商收益

關鍵詞：價格機制、廠商收益、雙網、服務品質(QoS)、差別服務機制(DiffServ)

英文摘要

The issue of QoS (Quality of Service) is becoming more and more important in the future heterogeneous networks integration, and the most feasible integration is UMTS and WLAN as for present network environment. In this research, we would propose the concept of Pricing-Improved QoS which combine those advantages of Usage-based, Non usage-based, Static pricing, Dynamic pricing schemes, and the mechanism of differentiating service classes according to DiffServ (Differentiated Services). We would then design utility function and cost function, and determine the prices using Third-Degree Price Discrimination and Two-Part Tariff strategies. Under the pricing mechanism, users will show their expectations of service levels they need, and the service providers can thus allocate the network resources appropriately avoiding inefficient resource usages. We expect the proposed methodologies could help to meet the QoS requirements and increase overall social welfare and providers' revenue. At the end, we will employ network simulator, using VoIP, video phone, video streaming, and FTP four distinct traffic models, to

- Calculate the optimal user number for each service class
- Verify the effectiveness of bandwidth allocation for each service class
- Verify whether QoS requirement for each service class can be meet
- Verify whether providers' revenues will be increased

Keywords: Pricing, Provider Revenue, UMTS/WLAN, QoS, DiffServ

(II) 報告內容及參考文獻

本報告內容節錄自下列發表論文：

Hung-Chin Jang, Bohan Lu,"Pricing-Enabled QoS for UMTS/WLAN Network,"the 9th International Conference on Computer Science and Informatics, Kaohsiung, Taiwan, Oct. 2006. (EI)

1. Introduction

In recent years, economic pricing theory has been applied to communication service market. With this, service providers could provide enough incentives for users to use network resources more efficiently and thus realize the potential preferences of users. In this research, we study how to apply the economics to enhance the management and allocation of network resources to meet the QoS requirement. Besides, we improve providers' revenue by using economic analysis. We believe that the increasing revenue would give providers incentive to invest more in development of network infrastructure and related researches. This virtuous circle will definitely contribute to the development of whole communication network and derivative services.

To simplify the real problem, many proposed researches usually assumed that the market is perfect competition market, and there is no consideration of the integration of heterogeneous networks. Besides, most of the researches are verified by the mathematical analysis without simulation experiments. However, if we look at the telecommunication markets, the majority are oligopoly markets, and the existing providers do have influences on the markets. On the other hand, the integration of heterogeneous networks is the trend of communication market in the near future. In this research, we will propose the utility function and cost function, and use the third-degree price discrimination and two-part tariff to enhance the QoS for UMTS/WLAN integrated network. Finally, we will verify the proposed method by simulation and evaluate the performance in terms of delay of each service class. The rest of the paper is organized as follows. Section 2 proposes our pricing strategies and QoS service class mapping, utility function, cost function, third-degree price discrimination and two-part tariff. Section 3 shows some simulation results. Section 4 concludes this research.

2. Pricing Strategy and Service Class Mapping

In this section, we will justify how the proposed pricing strategy would enhance the QoS. First, we introduce how the DiffServ would operate in UMTS/WLAN integrated network. Second, we define the mapping between QoS classes in UMTS/WLAN and DiffServ PHBs. Third, we propose the utility function of the consumer and cost function of the manufacture in detail. Finally, we elaborate on how the utility function, cost function, and QoS service class mapping would work with third-degree price discrimination and two-part tariff.

2.1 UMTS/WLAN with DiffServ

In this research, we adopt the tight coupling scheme as our integrated UMTS/WLAN network structure. We would describe how UMTS/WLAN would interwork with DiffServ in the following. Before we go on, we assume that the UE (User Equipment) and GGSN (Gateway GPRS Support Node) would support the edge functions of DiffServ, and the backbone IP network is also DiffServ enabled.

The overall end-to-end resource management structure for QoS could be divided into three layers. The highest and lowest layers are the IP and RAB (Radio Access Bearer) manager, respectively. The middle layer is the UMTS BS (Base Station) manager. DiffServ mechanism would be combined within IP manager layer and this manager is unaware of the underlying transport technologies. The mapping of QoS requirement between DiffServ and UMTS QoS management mechanism should also be defined in the UMTS BS manager layer. UMTS QoS control mechanism supports per-flow resource allocation and other control. This would be achieved by employing UMTS PDP context. Beyond the UMTS GGSN in the external IP network, it is expected that the evolving IETF standards DiffServ would provide sufficient QoS control and traffic engineering for various services.

The end-to-end QoS is provided by a local mechanism in the UE, the PDP Context over the UMTS access network, DiffServ through the backbone IP network, and DiffServ in the remote access network. Fig. 1 shows the operation of DiffServ in UMTS, the same concept is applicable to UMTS/WLAN network.

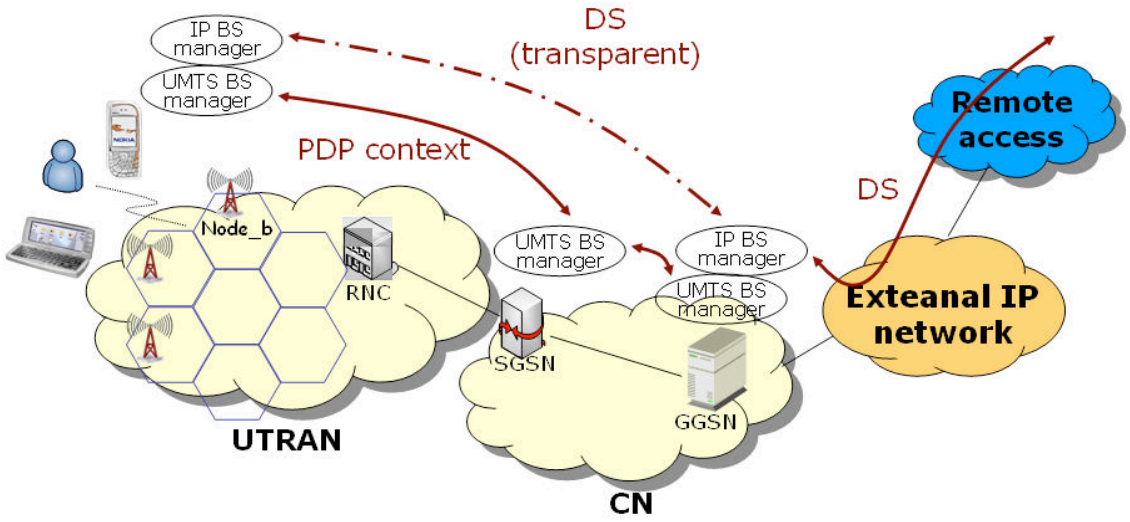

Fig. 1：End-to-end all-IP scenario with DiffServ [3]

2.2 QoS Class Mapping

The QoS classes mapping between UMTS, WLAN and DiffServ, respectively, are required to be adapted to the DiffServ structure.

PHB	DSCP			
EF PHB	101 110			
AF PHB	Class 1	Class 2	Class 3	Class 4
Low drop precedence	AF11 (001 010)	AF21 (010 010)	AF31 (011 010)	AF41 (100 010)
Medium drop precedence	AF12 (001 100)	AF22 (010 100)	AF32 (011 100)	AF42 (100 100)
High drop precedence	AF13 (001 110)	AF23 (010 110)	AF33 (011 110)	AF43 (100 110)
Best effort	000 000			

	Traffic class	Delay bound		Traffic class	Delay bound
UMTS	Conversational	400 ms	WLAN	Voice	400 ms
	Interactive	4 s		Video	4 s
	Streaming	10 s		Best effort	
	Background			Background	

Table 1：Proposed QoS Class Mapping

The QoS class mapping among UMTS, WLAN and DiffServ are summarized in Table 1. We classify the Conversational class of UMTS and the Voice class of WLAN into EF PHB. Besides, the Interactive class of UMTS and the Video class of WLAN are classified into AF42 PHB. The Streaming class of UMTS and the Best-effort class of WLAN are classified into AF33 PHB. This mapping is referred to the method used by RADIUS. The lowest Background classes are classified into Best-effort PHB.

2.3 Utility Function

The utility function consists of the common and idiosyncratic tastes. Common taste is a function expressed by $v(\cdot)$. It denotes the observable utility that any user could obtain from the consumption of the same product. Idiosyncratic taste, denoted by a variable ε, is the unobservable utility that a user would have from the consumption of the same product. We also add a positive parameter μ for ε to show the weight of idiosyncratic taste over the total taste. The larger is the μ, the more important is the idiosyncratic taste. The overall utility of each user could be expressed by equation (1).

$$u(\cdot) = v(\cdot) + \mu \cdot \varepsilon_i \tag{1}$$

Here we define the common taste function as follows,

$$v(\cdot) = a_i + (I_i \cdot cs \cdot rb) \cdot (\ln(\tfrac{x_i}{rb \cdot rt}))^2 - p_i^T - (S_i \cdot cs \cdot ad_i \cdot rb) \cdot \ln(\tfrac{x_i}{rb \cdot rt})$$

(2)

i：the service class

x：the bandwidth that a user consumes or obtains (kbps)

a_i：the basic utility that users will obtain in each service class

I_i：the index of the service class, if i > j then $I_i > I_j$

cs：cell scale factor, here we assume that umts=1, wlan=0.1

rb：the factor of bandwidth requirement of selected application

rt：the buffered factor

p^T_i：the fixed charge of each class

S_i：used to parameterize the sensitivity of each class to either congestion or delay

ad_i：average delay of each class

$(S_i \cdot cs \cdot ad_i \cdot rb) \cdot \ln(\frac{x_i}{rb \cdot rt})$ ：the congestion cost of each user.

In order to calculate the total demand functions of each service class, we further assume the number of users of each service class in the cells of UMTS and WLAN as follows.

The forecasted number of users				
	UMTS (20)		WLAN (20)	
EF	50%	10	20%	4
AF42	20%	4	35%	7
AF33	20%	4	35%	7
BE	10%	2	10%	2

Table 2：Assumption of the number of users of each service class in a cell of UMTS and WLAN

We assume that half the users are using voice application in UMTS and more than half the users are using video phone and multimedia streaming applications in WLAN. The total number of users in each cell is set to 20. According to the above assumptions, the demand function of each service class can be calculated according to equation (3), where the parameter n_i is the number of users of service class i.

$$\text{Total\_D}(x_i) = 2 \cdot (I_i \cdot cs \cdot rb \cdot n_i) \cdot \frac{\ln(\frac{x_i}{rb \cdot rt \cdot n_i})}{x_i} - (S_i \cdot cs \cdot ad_i \cdot rb \cdot n_i)\frac{1}{x_i} \qquad (3)$$

2.4 Cost Function

We define the cost function by using the envelope theorem as follows:

$$TC = Cost(x,k) = x \cdot f(\frac{x}{k}) + g(k) \tag{4}$$

x：bandwidth (kbps)

k：the capacity of the link (kbps)

$FC = g(k)$ ：Fixed Cost, means the rent of link

$TVC = x \cdot f(\frac{x}{k})$ ：Total Variable Cost, means the total congestion cost

$AVC = f(\frac{x}{k})$ ：Average Variable Cost

$MC = \frac{\Delta TVC}{\Delta x} = \frac{\partial TC}{\partial x}$ ：Marginal Cost

The total cost function consists of parameters x and k, which are the bandwidth and capacity of the link respectively. We then define the marginal cost function as equation (5), where BSCR stands for Base Station Cost Ratio.

$$MC = \frac{BSCR}{2000 \cdot k \cdot (1 - \frac{x}{k})^2} \tag{5}$$

2.5 Third-Degree Price Discrimination and Two-Part Tariff

The approximation of two-part tariff is based on Fig. 2 and formulae (6) to (8).

$$\text{Completed\_charge} = \frac{[\int_{Q^*}^{0} f(x)dx] - (P^*) \cdot (Q^*)}{n} \tag{6}$$

$$\text{Approximated\_charge} = \frac{[\int_{Q^*}^{Q'} f(x)dx] - (P^*) \cdot (Q^* - Q')}{n} \tag{7}$$

$$Q' = (50\%) \cdot Q^* \tag{8}$$

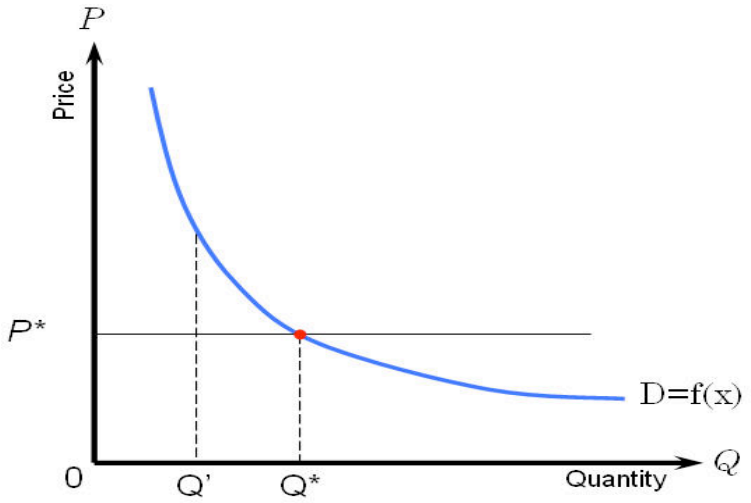

Fig. 2：Approximation of two-part tariff

The final results of allocation bandwidth, discrimination price and fixed charge of two-part tariff are shown in Tables 3 and 4.

Discrimination price and Allocation bandwidth Calculation				
	UMTS		WLAN	
	x	p ($/kb)	x	p ($/kb)
EF	399	0.00281	139	0.00031
AF42	285	0.00275	433	0.00030
AF33	215	0.00242	327	0.000027
BE	1	0.00082	1	0.00009

Table 3：Allocation bandwidth and discrimination price

Two part tariff price calculation		
	UMTS	WLAN
EF	0.501	0.105
AF42	0.578	0.134
AF33	0.508	0.094
BE	0	0

Table 4：Fixed charge of two-part tariff

3. Simulation and Analysis

To evaluate the effect of bandwidth allocation based on our pricing mechanism, we perform two experimental scenarios. The only difference is the bandwidth allocation of each service class. In scenario 1, the bandwidth allocation of each service class is determined by our pricing mechanism. Those of scenario 2 is determined by the user ratio. Table 5 shows the allocated bandwidth of each service class in these two scenarios.

Allocation bandwidth				
	Scenario 1		Scenario 2	
	UMTS	WLAN	UMTS	WLAN
EF	399	139	450	180
AF42	285	433	180	315
AF33	215	327	180	315
BE	1	1	90	90

Table 5：Allocation bandwidth of each service class in two scenarios

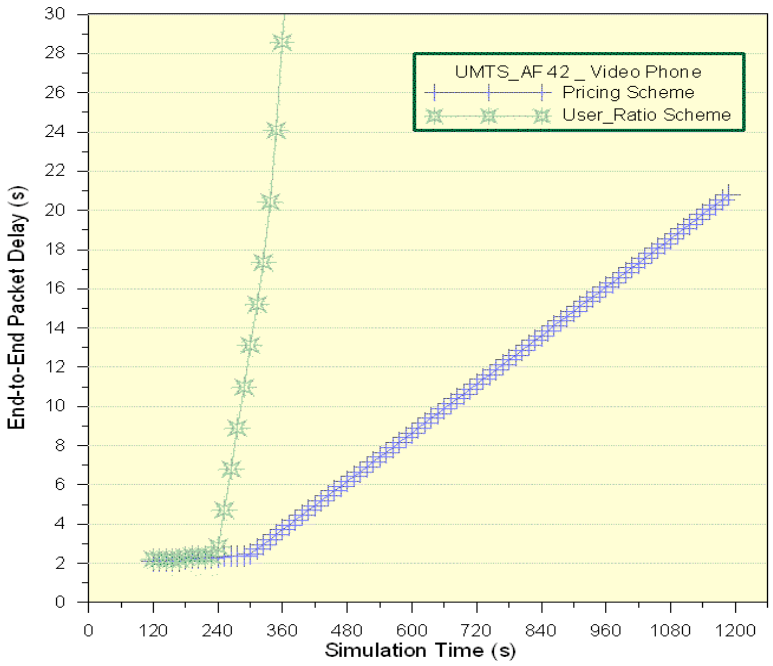

Fig. 3：E2E packet delay of UMTS video phone application of two scenarios

Fig. 3 shows the packet end-to-end delay of UMTS video phone application of two scenarios. Because in both scenarios the allocated bandwidth is insufficient to support the highest traffic load when all users have performed the application, delay time would not fulfill the QoS requirement when traffic load exceeds the allocated bandwidth. In both scenarios, delay time keeps stable in about 2s and then rapidly increases when the traffic load exceeds total allocated bandwidth, which are after simulation time 300s and 240s, respectively. Both scenarios did not allocate enough bandwidth so delay time would finally exceed 4s. Our method (scenario1) could efficiently slow down the rate of increase in delay time about 80% and extend the possible service time with QoS for 50% comparing to that of scenario 2 in the worst-case.

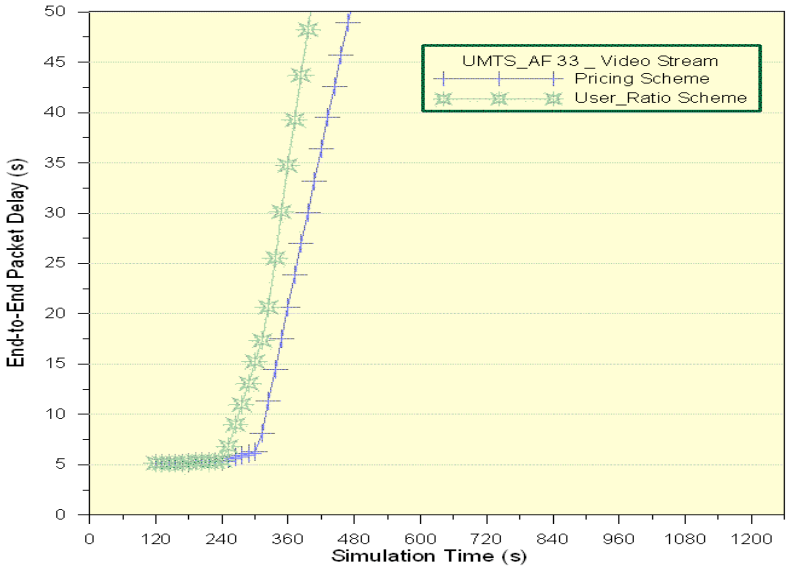

Fig. 4：E2E packet delay of UMTS video stream application of two scenarios

Fig. 4 shows the packet end-to-end delay of UMTS video stream application of two scenarios. It is similar to the previous AF42 class. Both scenarios did not allocate enough bandwidth. The allocated bandwidth is insufficient to support the highest traffic load when total users have performed the application. In both scenarios, delay time keeps stable in about 6s and then rapidly increases when the traffic load exceeds the allocated bandwidth, which are after simulation time 300s and 240s, respectively. Delay time would not fulfill the QoS requirement and finally exceeds 10s when traffic load exceeds the allocated bandwidth. Our method (scenario1) could still slow down the rate of increase in delay time about 30% and extend the possible service time with QoS for 25% comparing to that of scenario 2 in the worst-case.

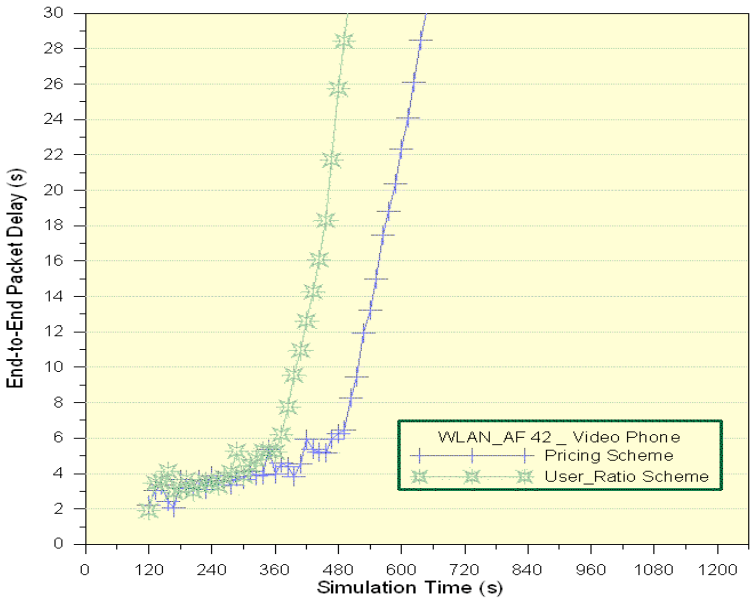

Fig. 5：E2E packet delay of WLAN video phone application of two scenarios

Fig. 5 shows the packet end-to-end delay of WLAN video phone application of two scenarios. Although our method (scenario1) is able to allocate more bandwidth to WLAN AF42 class than scenario 2 does, the bandwidth is still insufficient to support the highest traffic load when all users have performed the application. The delay time would not fulfill the QoS requirement when traffic load exceeds the allocated bandwidth. Delay time is less than 4s and increases slowly before 300s in both scenarios. Delay time of scenario 2 begins to increase rapidly after 300s because the bandwidth is now unsatisfactory. In scenario 1, this situation would take place until 420s. We could see that our method has less delay time at any simulation time comparing to that of scenario 2. Furthermore, it also slows down the rate of increase in delay time about 60% and extends the possible service time with QoS for 40% comparing to that of scenario 2 in the worst-case.

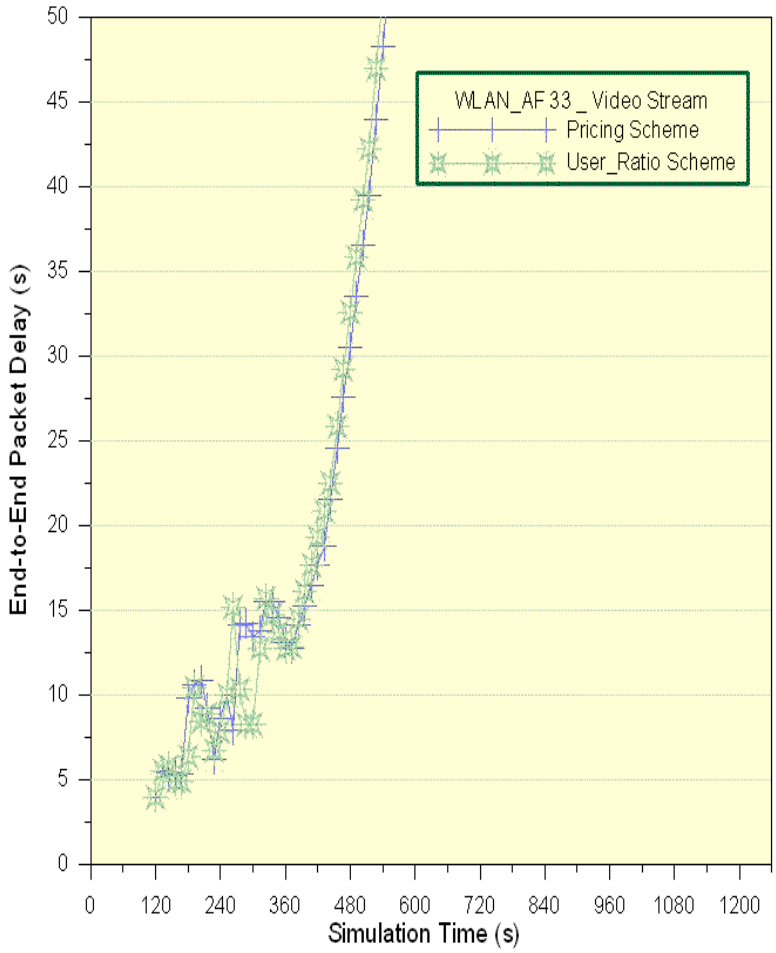

Fig. 6：E2E packet delay of WLAN video stream application of two scenarios

Fig. 6 shows the packet end-to-end delay of WLAN video stream application of two scenarios. Both scenarios do not have enough bandwidth. The allocated bandwidth is insufficient to support the highest traffic load when total users have performed the application. The delay time would not fulfill the QoS requirement and finally exceeds 10s when traffic load exceeds the allocated bandwidth. Simulation results of two scenarios in this class are very close. Delay time exceeds the bound of 10s at simulation time about 300s and 240s in scenario 1 and 2, respectively. However, our method (scenario1) still has some improvements. It slows down the rate of increase in delay time about 10% and extends the possible service time with QoS for 25% comparingto that of scenario 2 in the worst-case.

4. Conclusions

This research applied economic pricing strategy with DiffServ to integrated UMTS/WLAN network to meet the QoS requirement. With limited bandwidth, the system is able to allocate suitable network resources to each service class using pricing theory. The simulations showed that the system can not only make users use network resources more efficiently but also increase the revenue of manufactures. This virtuous circle will certainly contribute to the development of whole communication network and derivative services.

5. References

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(III) 計畫成果自評部份

近年來，政府致力於資訊技術的普及和寬頻網絡的建設，以建設台灣為資訊化社會。其中「數位台灣計畫」，即致力將台灣打造成一新的數位科技島，發展數位經濟的新平台。透過該計畫的實施與推動，台灣在資訊基礎建設、政府與產業電子化和社會資訊化等方面皆有長足的進展。根據Point Topic的調查報告，截至2003年底全球包含xDSL、Cable modem及其它寬頻技術之線路已達1億80萬條。其中台灣地區寬頻線路的建設排名全球第九。此外，台灣的寬頻滲透率僅次於南韓、香港與加拿大，排名全球第四，且單就DSL滲透率而言，排名僅次於南韓，名列全球第二。「數位台灣計畫」在達預期目標後，行政院更進一步提出另一國家級電信計畫「M台灣」，即行動台灣，具體的說法應稱為雙網計畫，包括WLAN及GPRS的網路環境，目標在建立世界第一個雙網服務的環境，帶動第三個兆元的通信產業發展，並計劃於五年內提升台灣的資訊運用國際競爭力至前五名。

基本上，M台灣計畫實為網際網路基礎建設，雖然由前述的調查數據中，台灣的網路滲透率及普及率高居全球前十名，但絕大多數的網路基礎建設皆由公營時期的中華電信所完成。在中華電信民營化後，正式卸下其過去數十年來，對台灣電信網路建設的貢獻與責任，在民營化的市場中，網路基礎建設的責任將由政府與所有的民營電信公司共同承擔，雖然要求中華電信開放用戶迴路為政府既定政策，但此部分的爭議與討論卻未曾停止；一般民營電信公司對網路的基礎建設，在某些因素的影響下慢如龜步，因此「Last Mile」的問題也一直無法有效解決。為提供更多的可用資源於未來發展，政府必須投入更多的網路基礎建設，此即行動台灣計劃的目標之一；解決用戶迴路問題、促進市場競爭以及整合行動與無線上網，形成全國雙網無縫式架構。

網路的應用儼然成為新興的經濟媒介，也將是國家新的競爭力來源。根據研究，歐美先進國家在網路上的投資大大提升了企業與總體經濟的表現，不但有效提高生產力，促進商業貿易，尚且改善人民的生活品質，在教育、健康、娛樂、通訊上增加不少便利性。網路與相關的資訊通訊產業，存在相輔相成的效果，政府協助這些產業的發展，受惠的不止是該產業本身，而是整體經濟。因此，政府投資網路的基礎建設，所創造出的利益不只是使得通訊成為第三個兆元產業而已，而將會帶動台灣整體經濟升級。

行動台灣計劃積極於全台各都會區及觀光區部署無線網路(WLAN)環境，台北市的網路新都計畫，預計將於2006年底完工，以及陸續推動的M-台北和M-
高雄，都將投入大量的無線網路基礎建設。而手機的普及率，台灣也名列世界第一。在此環境下，台灣將是發展雙網整合(UMTS/WLAN)的絕佳環境，如果雙網整合計畫能在台灣實現，則雙網整合的技術，將為台灣創造IT技術方面的領先，亦可帶動資訊娛樂產業和整體經濟的蓬勃發展。

在雙網整合的環境下，除了服務品質(QoS)的要求外，亦產生許多相關的議題值得探討，服務品質的提供將是未來雙網環境下，各類應用服務是否能被市場接受的重要因素，亦是決定市場使用者數目的一個重要因素，也直接關係著雙網環境的成敗。服務品質已有許多相關的研究成果可供參考，本計畫嘗試使用另一種觀點來探討QoS，著重於雙網環境下價格機制與服務品質的討論，結合經濟學的訂價理論，對不同的使用者與服務等級訂定合理的價格，以及其對QoS所可能的影響，並於模擬器中驗證此環境與價格機制的合理性。這些研究的結果，可做為將來雙網環境中QoS與價格訂定的參考依據，亦可作為政府未來評估雙網市場健全性的一項參考。本計畫將是一跨領域且極具前瞻性的研究。

出席國際學術會議心得報告

計畫編號	NSC 95-2221-E-004-002
計畫名稱	雙網環境下藉由價格機制改善服務品質與提高廠商收益之研究
出國人員姓名 服務機關及職稱	國立政治大學資訊科學系張宏慶副教授
會議時間地點	1/23/2008 ~ 1/25/2008, Busan, Korea
會議名稱	The International Conference on Information Networking 2008 (ICOIN2008)
發表論文題目	OVSF Code Based Framework to Support QoS for WCDMA

參加會議經過及與會心得

本人於97年1月23日至1月25日參加由IEEE Communications Society主辦，在韓國釜山舉辦的The International Conference on Information Networking 2008 (ICOIN2008)。INCOIN為IEEE所主辦在通訊網路領域中極富盛名的國際研討會，每年均有來自世界各地的優秀學者及通訊網路業者共襄盛舉，今年已是第二十二屆的盛會。本次會議涵蓋當今通訊網路領域中最重要的十三大主題，分別為Ad hoc and sensor network、Applications and services、Multimedia communications、Home networking、Measurement and performance analysis、Traffic management、Next Generation Internet、Mobile and wireless networks、Network and transport layers、QoS and resource management、Network management、Security、Ubiquitous networks。本次會議計有106篇論文發表，外加其餘自行參加學者，與會人數超過一百五十人。Keynote speech由Hankuk University of Foreign Studies的II-Young Chung教授主講，題目為：“New Challenges in Multimedia Networking: IPTV”。本人報告論文題目為OVSF Code Based Framework to Support QoS for WCDMA，該篇論文獲得與會者的熱烈迴響。本研究的重要研究成果如下：

Wideband Code Division Multiple Access (WCDMA) uses Orthogonal Variable Spreading Factor (OVSF) codes to support diversified data transmission rates and quality of service (QoS). In this paper, we propose a OVSF code based framework to support QoS for WCDMA. This framework is based on several effective mechanisms of traffic classification, service group selection, OVSF code allocation and dynamic code reallocation. Simulations show that the proposed method has performance advantages in system utilization, code blocking probability, throughput, code reallocation and packet delay.

研討會議程如附件一及附件二，其它相關資訊請參見網站 http://icoin.org/index2.html。

附件一：研討會議程

DATE	ROOM 1	ROOM 2	ROOM 3
Jan 23rd Wednesday (2:00 PM - 3: 25 PM)	Ad hoc and sensor network 1	Home networking	Applications 1
Jan 23rd Wednesday (4:00 PM - 5: 25 PM)	Mobile and wireless networks 1	Network and transport layers 1	Traffic management/ NGI 1
Jan 24th Thursday (10:30 AM - 11: 55 AM)	Ad hoc and sensor network 2	Network and transport layers 2	Multimedia communications
Jan 24th Thursday (1:30 PM - 2: 55 PM)	Mobile and wireless networks 2	Applications 2	Traffic management/ NGI 1
Jan 24th Thursday (3:30 PM - 4: 55 PM)	Ad hoc and sensor network 3	Ubiquitous networks	QoS and resource management 1
Jan 25th Friday (9:00 AM - 10: 25 AM)	Mobile and wireless networks 3	Applications 3	QoS and resource management 2
Jan 25th Friday (11:00 AM - 12: 50 PM)	Ad hoc and sensor network 4	Network management and security	Measurement and performance analysis

附件二：ICOIN2008 Advanced Program

Session	Paper Title	Authors
Ad hoc and sensor network 1	Statistical Energy Efficient Multipath Routing Protocol	Shirshu Varma (Indian Institute of Information Technology Allahabad)
	Outage Probability Analysis of WPAN under Coexistence Environments in Fading Channels	Sangjin Han (Yonsei University)
	ODTPC: On-demand Transmission Power Control for Wireless Sensor Networks	Junseok Kim (University of Konkuk)
	Network Supporting Middleware for New Networks with Geographical Location Information	Soonwook Hwang(Korea university)
	UDDN: Unidirectional Data Dissemination via Negotiation	Indrajit Banerjee (Bengal Engineering and Science University)
Ad hoc and sensor network 2	An Energy-Efficient In-network Join for Event Detection in Sensor Networks	Joo Hyuk Jeon (KAIST), Myoung Ho Kim (KAIST)
	Processing Sliding Windows over Disordered Streams	Hyeon Kim (Ph.D Candidate)
	New Multichannel MAC Protocol for Ad Hoc Networks	Wessam Ajib (Universite de Quebec a Montreal)
	An Effort to Understand the Optimal Routing Performance in Wireless Sensor Network	Qinghua Wang (Mid Sweden University)
	Lifetime Maximization in a Cluster based Wireless Sensor Networks	ines Slama (institut national des communications)
Ad hoc and sensor network 3	Data collection in wireless sensor networks using mobile base stations and geographic forwarding	Mirko Dal Pozzo (University o Ferrara)
	Group Source Routing Protocol with Controlled RREQ Flooding for Mobile Ad Hoc Networks	NAM TUAT (Ulsan University)
	A Cluster?based Routing Protocol for Supporting Mobile Sinks in Sensor Network	Jieun Cho (Sookmyung women's University)
	Energy-Efficient Flooding Mechanisms for the Wireless Sensor Networks	Sanghyun Ahn (University of Seoul)
	Balanced Energy-Efficient Routing in Mobile Ad Hoc Networks using Reinforcement Learning	Wipawee Usaha (Suranaree University of Technology)
Ad hoc and sensor network 4	Hybrid Routing Scheme based on Geographical Information for Wireless Multihop Internet Access	Su-Jin Lee(Korea University)
	Low Latency MAC Protocols	Seung Sik Choi (University of Incheon)
	TCP Performance Over MANET	Uchennaya Ibom (Beijing University of Post and Telecommunication)
	Energy Efficient Dynamic S-MAC protocol for Sensor Network	Dae-suk Yoo (Incheon University)
	Efficient Data Gathering Mechanism for Mobile Sink in ZigBee Network	Hyoung Seok Lim (Master course)
	A New Route Maintenance Strategy for Dynamic Source Routing Protocol	Muhammad Farhan Sjaugi (Universiti Putra Malaysia)
Applications and services 1	Leveraging Missing Values in Call Detail Record Using Naive Bayes for Fraud Analysis	Khairul Nizam Baharim (Telekom Research & Development)
	P2PConf: A Medium-Size P2P Internet Conference with Effective Floor Control	Yuh-Jzer Joung (National Taiwan University)
	Rule-based Dynamic Business Process Modification and Adaptation	Jin Hyun Son (Hanyang University)
	A Bucket ID Transformation Scheme for Efficient Database Encryption	Dong Hyeok Lee (ETRI)
	Surveillance Tracking System Using Passive Infrared Motion Sensors in Wireless Sensor Network	Byunghun Song (KETI)
Applications and services 2	Development of a WS-ECA Framework for a Healthcare Robot Platform	Jaeil Park (Ajou university)
	Rearrange Broadcast Schedules on DHT-Based P2P Networks	Jeng-Wei Lin (Tunghai University)
	Presence Functionality Approach to Achieve Fixed Mobile Converged Services	Victoria Beltran (Technical University of Catalonia (UPC))
	Conceptual Service Architecture for Adaptive Mobile Location Services	Saowanee Schou (Technical University of denmark)
	Context-based Service Adaptation Platform: Improving the User Experience towards Mobile Location Services	Saowanee Schou (Technical University of denmark)
Applications and services 3	Optimum Transmission Range for Underwater Acoustic Sensor Networks	Jinfeng Dou (Ocean University of China)
	A Grid-Based Architecture for Recording and Replay of Civil-Engineering Hybrid Remote Experiment	Jang Ho Lee(Hongik University)
	Code Graph for Malware Detection	Kyoochang Jeong (Korea University)
	Cognitive Lattice Model for Service Adaptation Middleware	Svetlana KIM (Sookmyung Women University)
	On the Impact of P2P File Sharing Traffic Restrictions on User Perceived Performance	
Multimedia communications	Cooperative Transmission Strategy for Video-on-Demand System	King Man Ho (The Hong Kong Polytechnic University)
	Investigating the Performance of Hierarchical Video-on-Demand System in Heterogeneous Environment	King Man Ho (The Hong Kong Polytechnic University)
	Offloading VoD Server Organized Dynamically Distributed Cache Using P2P Delivery	Ryousei Takano (AIST)
	Multicast Session Management and QoS Management for Multicast Group Communications	Jung-Jin Park (Korea University)
	MAC-Centric Cross-Layer Framework for Video Streaming in IEEE 802.11e Wireless Network	Hung-Chin Jang (National Chengchi University)
Home networking	Ubiquitous Audio Access in the UPnP Home Network	Chung-Ming Huang (National Cheng Kung University)
	Indoor Location Estimation Technique using UHF band RFID	Takehiro Shiraishi (Tokyo University of Technology)
	Location-Awareness for Mobile Users in the Pervasive Network Environment	Egun Jung (Kyungpook National University)
	A Communication Framework for an End-to-End Seamless Connections in Wireless Home Networks	Sungwoo Tak (Pusan National University)
	The Optimum Path Selection Mechanism For Inter-PAN Communication Using ZigBee	Ji Hyuk Heo (Kyung Hee University)
Measurement and performance analysis	LDHT: Locality-aware Distributed Hash Tables	Weiyu Wu (Tsinghua University)
	Packet Interference and Aggregated Throughput of Bluetooth Piconets Using an Adaptive Frequency Hopping in Rician Fading Channels	Seung Yeon Kim (Korea University)
	The Ethernet frame payload size and its effect on IPv4 and IPv6 traffic	Nuno Garcia (Siemens / University of Beira Interior)
	Performance Enhancement of IEEE 802.11s Mesh Networks using Aggressive Block Ack Scheme	Arun Ranjitkar (Ajou University)
	Energy Analysis of Multimedia Video Decoding on Embedded Systems	Chu-Hsing Lin (Tunghai University)
Traffic management / NGI 1	Packet transmission control of preventing the perceptual video quality deterioration in all IP-based network	Kenichi Hatakeyama (Student)
	A Simple Approach of Improving DNS based CDN Video Sharing System	Yiping Zhang (Beihang University)
	Heuristics to Classify Internet Backbone Traffic based on Connection Patterns	Wolfgang John (Chalmers University of Technology)
	End-to-end QoE Optimization Through Overlay Network Deployment	Bart De Vleeschauwer (Ghent University)
	The Internet Traffic Classification an Online SVM Approach	Yu Liu (Alcatel-Lucent Technologies)
Traffic management / NGI 2	The Multiple User Real-time Navigation Information System Combined with MIMO and Ant Genetic Program	Gwo-Jiun Horng (National Kaohsiung University of Applied Sciences)
	SANET: A Step Toward Multidimensional Extensible Router	Lv GaoFeng (National University of Defense Technology)
	A Novel Architecture for securing data delivery in Internet	Aroua Biri (INT evry)
	Efficient Load Balancing System for Overlay Multicast	Kwangman Koh(Konkuk University)
	All-IP Computer Architecture	Kouji Okada (Keio University)
Mobile and wireless networks 1	Joint Transmission and Detection in Hexagonal Grid for 3GPP LTE	Andreas Ibing (Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut)
	Cross-layer based Fast Handover Mechanism for Seamless Macro-mobility Support in WiBro Networks	Hwasung Kim (Kwang Woon University)
	Seamless Handover with Buffer Prediction for Wireless Networks Based on IEEE 802.21	Yu-Chin Wang (Tamkang university)
	A Downlink Rate Adaptation Scheme in IEEE 802.11 WLANs using Overhearing	Jong ho Won (Seoul National University)
	Network Selection in Wireless Heterogeneous Networks:A Ranking Algorithm	Joydip Dhar (ABV-Indian Institute of Information Technology and Management, gwalior)
Mobile and wireless networks 2	Extension of multiple care-of-address registration to support host multihoming	Phuoc Nguyen Tran (ENST Paris)
	Mobile Peer-to-Peer systems using Super peers for Mobile Environments	Jung Suk Han (Yonsei University)
	Adaptive MAC Protocol for Throughput Enhancement in Cognitive Radio Networks	Byungjoo Lee (Kwangwoon University)
	An Efficient Clustering Scheme in Mobile Peer-to-Peer Network	Ke Zuo (College of Computer Science, National University of Defence Technology)
	Inter-System Handover on a Cellular Level in a Hierarchical Structure	Henrik Persson (Lund University)
Mobile and wireless networks 3	A Method for Optimal Bandwidth Utilization in IEEE 802.11 WLAN Networks	HuKeun Kwak (University of Soongsil)
	Distributed Backoff Reservation and Scheduling for Collision Mitigation in IEEE 802.11 WLANs	Eun jun Choi (Korea university)
	Mitigating Co-Channel Interference in CSMA/CA Networks via a Cell-Delimited Payload Retention Scheme	Raymond Jayabal (Institute for Infocomm Research)
	Efficient Polling MAC Scheduler for IEEE 802.11 WLAN	Jaeyeon Kim (Korea University)
	Aeronautic Channel Estimation Methods Based on GAIC and RPC for OFDM System	He Jian (Northwestern Polytechnical University)
Network and transport layers 1	A Locality-Based LFH Cluster Strategy for Overlay Network	Xing Chen (Institute of Automation, Chinese Academy of Science)
	A Simple Model for Peer-to-Peer Video-on-Demand System in Broadcast Environment	King Man Ho (The Hong Kong Polytechnic University)
	Design and Analysis of an XCP-TCP Gateway	Cheng Shuangmei (Shanghai Jiaotong University)
	Application-Level Fairness	Jussi Kangasharju (University of Helsinki)
	Enhanced Response Algorithm for Spurious TCP RTO(ER-SRTO)	Inkeun Cho (Yonsei University)
Network and transport layers 2	Multi-level BGP Backup Routing	Changjin Suh (SoongSil Univ.)
	Implementation and Evaluation of a Generic IP Signaling Protocol	Nadia Boukhatem (ENST)
	A Multi-Level Super Peer Based P2P Architecture	Cao Zhao (Beijing Institute of Technology)
	A Feasible Solution for Surviving Multi-link Failures in Shared Protected WDM Mesh Networks	Xuetao Wei (University of Electronic Science and Technology of China)
	Hop-Count Based Congestion-Aware Multi-path Routing in Wireless Mesh Network	Hung Vo (Kyung Hee University)

QoS and resource management 1	Policy-based End-to-End QoS Guarantee Using On-Path Signaling for Both QoS Request and Feedback	Yasusi Kanada (Hitachi, Ltd.)
	A CRN Discovery and Local Repair Mechanism using QoS-NSLP signaling in HMIPv6 Networks	Haesun Byun (Ewha Womans University)
	An Analysis of Star Topology IEEE 802.11e Networks in the Presence of Hidden Nodes	Katarzyna Kosek (AGH University of Science and Technology)
	Proportional Delay Differentiation in Multi-hop Wireless Networks	Hyunduk Jung (Yonsei University)
	OVSF Code Based Framework to Support QoS for WCDMA	Hung-Chin Jang (National Cheng-Chi University)
QoS and resource management 2	Channel Quality-based Rate Adaptation Scheme for Wireless Networks	Sunhun Lee, Kwangsue Chung(Kwangwoon University)
	A Novel Cross-Layer QoS Routing Algorithm for Wireless Mesh Network	Chi (Harold) Liu (Imperial College)
	Dynamic Resource Allocation in Cellular Radio Networks with Downlink Relaying	Hyunduk Jung (Yonsei University)
	A Cross-Layer Based Rate Control Scheme for MPEG-4 Video Transmission by Using Efficient Bandwidth Estimation in IEEE 802.11e	Pilgyu Shin, Kwangsue Chung (Kwangwoon University)
Network management / security	Toward A Practical Scheme for IPSec Management	Qi Li (Tsinghua University)
	An Integrated Network Management System for Multi-Vendor Power Line Communication Networks	Chang-Keun Park (POSTECH)
	A High Performance and Scalable Packet Pattern-Matching Architecture	Mingjiang Ye (Tsinghua University)
	Vertex-based Shared Data Allocation in a Mobile Computing System	JinWoo Song (Yonsei University)
	Fast Re-Authentication for Inter-Domain Handover using Context Transfer	Omar Alfandi (University of Goettingen)
	Preserving Identity Privacy in Wireless Mesh Networks	Md. Sharif Islam (Kyung Hee University)
Ubiquitous networks	Infrastructure Sharing for Mobile Network Operators - From a Deployment and Operations View	Thomas Frisanco (Nokia Siemens Networks)
	Towards Building File Sharing and Adaptation Service for Advanced Collaborating Environment	Mohammad Rezwanul Huq (Kyung Hee University, Korea)
	Localization of Sensor Nodes in Underwater Acoustic Sensor Networks Using Two Reference Points	Jae Ko (Pohang University of Science and Technology (POSTECH)
	Using Cross-layer Heuristic and Network Coding to Improve Throughput in Multicast Wireless Mesh Networks	Viet Do (College of Technology - Vietnam National University)
	Simple Ant Routing Alogirthm	Fernando Correia(Instituto Superior T´ecnico)