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Pricing the Internet: The One-Component versus Two-Component Pricing Mechanism - An Evaluation

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Abstract

This paper investigates the efficiency of one-component pricing mechanisms versus two- component pricing mechanisms. The paper deals with four pricing mechanisms used in the Internet, namely, flat rate pricing, usage-based pricing, transaction-based pricing and version-based pricing for the analysis. The objective of the paper is to evaluate and analyse the ways in which the usage-based pricing mechanism is more efficient than one-component-based pricing and this evaluation has been made in accordance with the four examples cited. The paper observes the efficiency of the two-component pricing mechanism structure from both the sellers' and buyers' perspective and clears the way for further research in this area.

1. Introduction

The Internet in Brief

The Internet has provided impetus for today's business and several business and pricing models have been designed. Assessing the value of the pricing mechanisms in the Internet is complicated owing to its nature: It is abstract and its value depends on its context, accessibility, speed, reliability and the like.

Historically, the Internet has put in place one service class and used technical means rather than pricing to allocate resources when the network is fully utilised and congestion occurs. Nowadays, the Internet is making the transition from being a partially subsidised service to becoming a commercial one with all costs recovered

through direct charges. There is a pressing need to demonstrate how pricing and cost recovery should be structured (van Alston 1998).

It is a misconception to assume that the Internet is free (McKnight & Bailey, 1995). However, Jackie-Mason and Varian (1993, 1995) have shown that while the marginal cost for Internet traffic may approach zero owing to statistical sharing, other costs, such as congestion costs, may be significant (McKnight & Bailey, 1995).

The paper is divided into the following sections: Firstly, we will briefly describe the Internet and the problem of efficiency. Next, we will look into the relevance of this paper and the research questions to be addressed, followed by the methodology applied in order to answer the questions raised. We will then outline the four pricing mechanisms in the Internet and categorise them under two groups; one-component pricing mechanisms and two-component pricing mechanisms. After this, we will briefly describe each of the four pricing mechanisms along with an example to support the view. In the next section we will evaluate each of the pricing mechanisms along with examples, basing this on certain criteria. The final section will deal with findings made regarding buyers' and sellers' benefits from using the pricing mechanisms. This will clear the way for further research into pricing information, communication and media infrastructures.

The Efficiency Problem

Internet services are supplied through networks with traffic moving over leased telephone lines using technology called "packet switching". This technology requires no connection to be made, meaning that there is no need to set up end-to-end when using the computer for a session. The main advantage of packet switching is that it permits "statistical multiplexing" on the communication lines. This means that packets from a variety of sources can share one line at the same time.

However, one of the biggest problems and challenges facing the Internet is that of congestion. This means that if the network becomes too overloaded, packets are dropped (Mackie-Mason & Varian, 1997).

In terms of costs, it is possible to argue that the main cost of providing an Internet service is often dependent on the level of the usage on the networks. Most of the costs are fixed. The incremental cost of sending additional packets is essentially zero if the network is not saturated (MacKie-Mason & Varian, 1995).

However, sometimes the network becomes congested and there is simply too much traffic for the routers and lines to handle. MacKie-Mason and Varian (1995) have identified this problem as the "classic problem of the commons", and suggested that as long as users have unlimited access they will tend to "overgraze", creating congestion that results in delays and dropped packets for other users.

There is also the debate within communities as to how the Internet service should be allocated in the future (Clark, 1995), since as Clark (1995) pointed out, there

is/will be many Internet services available, and the user will be able to select among these and pricing will be set accordingly.

2. Relevance, Questions and Approach

The Relevance

As the Internet makes its transition from a partially subsidised service to a commercial service (Clark, 1995), there is a pressing need for effective pricing and a cost recovery method (Clark, 1995). The issues raised by the Internet are not new (McKnight & Bailey, 1995). Accounting and pricing have been an issue for computer networks for some time. While work on development of the Internet has been largely technical to date (McKnight & Bailey, 1995), without new research and a deeper understanding of the other issues of the Internet like pricing policies, pricing structures, capacity allocation and the like, Internet growth may be stymed (McKnight & Bailey, 1995).

A further motivation for using a pricing scheme is to give users knowledge about the value that the Internet can offer. It is assumed that the system, which lends itself to congestion, also provides users with the power to reduce congestion and thereby avoid needless problems (Crawford, 1995).

Congestion, scarcity of bandwidth and improper resource allocation are serious problems the Internet must tackle in future and past proposals to control them have been unsatisfactory (MacKie-Mason & Varian, 1993). There is a pressing need for proper efficient pricing and cost structure to at least reduce the problem. As MacKie-Mason & Varian (1993) pointed out, the objective is not to raise profits but to find a pricing mechanism that will lead to the most efficient use of existing resources and will guide investment decisions appropriately. Furthermore, coming to the topic of network congestion, if it is properly priced, the revenues collected from the congestion surcharges can be used to fund further capacity expansion.

Research Questions

Accounting and pricing mechanisms have been an issue in the context of computer communications (Kleinrock, 1974). The paper discusses the issue of pricing mechanisms for the Internet. It asks which is the most efficient pricing mechanism in the Internet in terms of one- component pricing or two-component pricing. If one-component pricing mechanisms are better than two-component pricing mechanisms, then in what respect are they better and vice versa. In this paper we will use four pricing models: 'flat rate pricing', 'usage-based pricing', 'transaction-based pricing' and 'version-based pricing' for our detailed analysis and evaluation. What are the benefits of the respective models from both the sellers' and the buyers' perspectives? Are these pricing mechanisms helping to ease the above problems of

internet congestion and scarcity of bandwidth. Which is the most efficient one in eradicating some of the problems listed above?

Methodology

The study will give a better understanding of pricing policies and mechanisms. Since the study is an evaluation and comparative analysis of these pricing mechanisms, we will use the comparative study method in our evaluations. The primary objective of this analytical, descriptive and comparative research is to determine systematic and comparative effectiveness and the limitations of the different pricing mechanisms listed above. The pricing mechanisms will be evaluated on the basis of underlying criteria. Since these pricing mechanisms are also economic concepts, we will also be looking at aspects of economic modelling (Bergh & Hofkes, 1997, Midmore & Mayfield, 1996) as research methodology (Smith, 1987, Reich, 1994, Benbasat et al, 1987, Kaplan & Duchon, 1988, Barki & Hartwick, 1989) Economic modelling has helped in the development of efficient analytical reports and evaluation of economic issues and will therefore help us to answer questions we have set ourselves.

3. Pricing Mechanisms

Underlying Microeconomics

According to traditional pricing, in microeconomic theory pricing depends heavily on the market structure for a certain product or service (Varian, 1993). In the classic case of perfectly competitive markets with a variety of economic agents on each side, sellers are price takers and cannot influence prices (Kreps, 1990).

We find various pricing mechanisms on the Internet for the various services offered and also for selling information goods in the web (MacKie-Mason & Varian, 1993). Pricing is still a taboo subject (McKnight & Bailey, 1995) and there has been a lack of understanding and miscommunication over Internet pricing issues (McKnight & Bailey, 1995). We will use two groups to categorise the four pricing mechanisms which are:

- One-component pricing mechanisms and
- Two-component pricing mechanisms.

In this paper we hope to offer some clarity to the debate by defining the pricing models and categorising them into these two groups in order to evaluate and analyse them. Before that, it is necessary to explain what the traditional pricing structure comprises.

Varian and MacKie-Mason (1993) suggest that there are two basic components of pricing mechanisms:

1. An annual access fee or an initial connection fee and

2. A usage charge or a separate charge for the equipment (for example, a router to serve as a gateway between the customer network and Internet Service Provider, but there is not always a charge for this).

We classify number 1 as a one-component pricing mechanism (where there is only an annual access fee or a monthly subscription without any additional charges) and a two-component pricing mechanism where both 1 and 2 are present i.e. an annual access fee, a fixed connection charge or a monthly subscription plus an extra cost for daily usage of the Internet in terms of bit / bytes received or sent.

Assuming this, we can categorise the four pricing mechanisms to be described below as either one-component mechanisms or two-component mechanisms. The categorisation is made by analysing each mechanism's description, features and characteristics.

One-Component Pricing Mechanisms

Flat Rate Pricing: Users pay a fixed fee to connect, but subsequently do not pay anything for any bits received or sent by them. The advantage of using a flat rate system is that it avoids administrative overheads for billing systems. For example, a user may pay for a T1 link regardless of how many bits they receive or send. This is certainly a one-component pricing since there is just a one-off fee to get connected.

Transaction-based Pricing: In this pricing category the prices are determined mainly by the characteristics of the transaction and not by number of bits (McKnight & Bailey, 1995). The characteristics of transactions could be network characteristics such as responsiveness, service, speed, quality, reliability, throughput etc. (Varian 1993, Cocchi, Estrin, Shenker & Zhang 1991). Since the applications require different combinations of network to support these characteristics, some sort of pricing is needed to identify user demand for these characteristics (Varian & MacKie, 1993). This mechanism is a one-component pricing mechanism where the user only pays for the transactions they make.

Version-based Pricing: This is commonly referred to as versioning. Version-based pricing refers to differential pricing based on variations of the same underling product (Varian 1999). The product line is designed to appeal to different market segments, thereby selling at a high price to those who have a place a high value on the product and a low price to those who value it less. Versioning is a common strategy for conventional information goods. We would categorise this under the one-component pricing mechanism.

Examples of One-Component Pricing Mechanisms

AT&T Case: Flat Rate Pricing

In 1998 AT&T (www.att.com) premiered flat rate pricing for its wireless data service. It provides unlimited wireless data transfer for a variety of applications – including wireless e-mail, remote LAN and corporate Intranet access – for mobile

computing customers. The aggressive new plans ultimately simplify the wireless data pricing and allow AT & T customers to better anticipate monthly usage costs. The two new plans include:

- Local Unlimited, a monthly rate of $54.99, which carries an additional $0.20 per kilobyte roaming fee when users are outside of markets where AT&T operates wireless IP service, and
- National Unlimited, a monthly rate of $64.99 with roaming charges extra.

Wireless IP rates (also known as CDPD or Cellular Digital Packet Data) have historically used variable charges for each kilobyte of data the customer transmits over the network. The reason for implementing this is to introduce the "Digital One Rate" service. The new plans are designed for customers who use an IP compatible modem with their laptop, hand-held computer, PDA or a specialised portable device. The Local Unlimited plan will appeal to customers who use their wireless applications mainly in their local AT&T wireless IP markets, whereas the National Unlimited plan is designed for frequent travellers who need wireless access to information from various locations across the country. Both these plans would benefit customers who on average send and receive at least one MB of information by wireless a month, or whose usage levels vary monthly. However for other aspect relating to quality of services like monitoring traffic, transmission, congestion and the like are not provided.

Flat Rate Pricing, according to AT&T, will offer the user the ability to accurately budget for communication and media needs. Since remote access to data is becoming an increasingly vital tool for mobile professionals, AT&T's new data pricing plan will allow the user to utilise their investment in wireless technology without worrying about access costs.

Axxent's Case: Transaction-based Pricing

AXXENT (www.axxent.ca) is a leading Canadian competitive local exchange carrier (CLEC) providing high-speed data, voice and Internet services that can be customised to meet the needs of small and medium-sized enterprises.

Axxent's success is deeply rooted in its understanding that customers are the greatest asset. With over 34,000 businesses representing more than 126,000 access lines, AXXENT is Canada's largest CLEC in terms of the size of its operating footprint.

Axxent offers Global Internet Roaming in which customers can browse the internet for the price of a local call from anywhere in the world. This caters for customers who frequently travel a lot and use the Internet outside of Toronto. The benefits that customers receive are:

- Better quality Internet connections.
- One bill for all Internet and roaming charges.
- Roaming charges are extra (for local and long distance).

- Roaming also gives the customer proper authentication from any part of the world.

Another service offered by Axxent, which caters for transaction pricing, is that of DSL Internet. This is a high-speed data service offering a fast and reliable service for downloading files or attachments. DSL, which stands for Digital Subscriber Line, is a technology that uses existing copper telephone wires to deliver high-speed data services. Customers are actually paying for the quality, speed and reliability of the Internet service offered by Axxent. This is service which is "always on", meaning that unlike dial-up connections to the Internet, the DSL connection is always switched on.

Customers also has the provision to upgrade their service plans, for example, if the customer values speed of transmission or requires any other service, then they would have to pay a higher monthly rate associated with the increased service level. Axxent offers a full range of services such as quality of transmission, speed and service at a price which benefits the customer. But monitoring and reducing congestion and trafficking problem in the Internet remains to be seen. Facilities to provide these vital services are not properly implemented.

Bid2Bid Case: Version-based Pricing

Bid2Bid (www.bid2bid.com) is an auction company, which offers a convenient way to purchase name brand products and services. It is a live auction, where the customers can browse the continuously evolving inventory of brand new and remodelled (factory reconditioned) products.

To make this more convenient and to heighten tension, Bid2Bid always brings in new and different lines of products for every prospective buyer on the Internet. At Bid2Bid live auctions there are no reserves to meet with many auctions starting at one penny.

Since this is a live auction, at any point in time the customer can see the entire current active auction. To take part in the auction the customer has to be registered with the company with a username and a secured password. Once registered he/she can take part in the live auction. There is also scope for choosing from items from brands with specification, size, features and so on. However, the underlying problem with online auctions is that since auctions last for a long time it creates traffic congestion on the Internet.

The customer also faces the problem of cookies when the login prompt pops up on the screen, even if the customer has already registered. Furthermore, since the problem of congestion on the Internet is so frequent, there is the possibility that this could adversely affect the quality of service provided by online auctions in terms of performance, reliability, speed and access. This would cause further delays in making bids and would pose great difficulties to customers online when they buy the product or service.

Two-Component Pricing Mechanism

Usage-based Pricing: Users pay one portion of their bill for a connection charge and another portion for the bits received or sent. The marginal monetary cost of sending or receiving another bit is non-zero for part of the time. This is a case where there are two components present i.e., a charge for getting connected and subsequently marginal charges for using the services, precisely when bit / bytes are received or sent. This mechanism falls into the category of two-component pricing. However as McKnight & Bailey (1995) pointed out, it is possible, for example, to have usage-based pricing during peak hours and flat rate pricing during off-peak hours.

We will use usage-based pricing for the analysis in the rest of the paper since there are many conflicting definitions between usage-sensitive pricing and usage-based pricing (McKnight & Bailey, 1995), where some have used the term usage-sensitive instead of usage-based.

Connect's Case: Usage-Based Pricing

Founded in 1992, Connect (www.connect.com.au) was one of the first companies to bring the Internet to Australia. Today, Connect is a nationwide network provider and one of Australia's largest Internet access and e-commerce providers.

Connect has its own custom-built nationwide network. It means that Connect's customers enjoy the speed and reliability of a direct link to an Internet network. Connect's products run on an end-to-end Cisco Powered Network, meeting stringent criteria for quality of service and support must be met.

Connect has recognised that business requires value for money and that is why Connect is the first company in Australia to have come up with a usage-based billing (UBB) system.

The reason for this move was that Connect believed that what the customers pay should be based on what it costs Connect to deliver to the customer. As a result, they have come up with a fair pricing system which is offered by any Australian ISP. Connect believes that differential pricing gives the flexibility and the scope to make significant savings on Internet connection costs. It therefore also does systems monitoring of the traffic over each customer's link, which is free of charge, and thus provides customers with an online monthly traffic report.

Connect is Australia's only ISP to offer a four-tiered usage-based pricing system. Connect differentiates between these traffic-by-traffic types: external, cache, national and local. Connect's definition of usage-based pricing is as follows: "customers with permanent connections can choose to be billed by volume at a per megabyte charge using an innovative charging system known as Usage-Based Pricing (UBP)".

According to Connect UBP offers the customers the following:

- More control over cost of the connection.
- Choice of payment plans to give more flexibility.

- Substantial discounts to customers receiving traffic from Connect's web proxy cache.
- Significantly lower prices for domestic traffic and local traffic is free.

4. Evaluation Criteria for Comparing the Efficiency of Pricing Mechanisms

We will now analyse and evaluate the two pricing mechanisms with respect to the criteria listed below:

The evaluation criteria are chosen from the examples listed above and also from academic literature mentioned in the paper to reflect the nature of pricing mechanism. We will evaluate the efficiency process under two groups, i.e. one-component versus two-component mechanisms, and explain which is better in terms of efficiency and reducing the problem of congestion on the Internet.

The list of criteria selected for the evaluation process is as follows:

1. **Pricing**: It is an important criterion in analysing the efficiency of these two mechanisms. We will primarily restrict ourselves to analysing the examples. We will, for example, check whether any incentives, discounts, extra roaming charges and the like are being offered to customers or not.
2. **Monitoring traffic on the Internet**: As the paper discusses traffic and congestion on the Internet we will use this criterion as an important factor in determining the efficiency of the two pricing mechanisms.
3. **Transmission Speed**: Internet access for everyone means having faster access, high speed, fast downloads etc.: Important criteria for measuring the effectiveness and efficiency of the proposed pricing mechanisms.
4. **Quality of Transmission**: Customers want better quality, service, reliability from their ISPs. Whether customers are enjoying better quality in terms of proper connection to the Internet is also one of the basic factors determining effectiveness.
5. **Congestion**: The problem of congestion is an important criterion for this evaluation. Literature suggests that this problem is one of the most crucial problems. We will therefore take this factor to be one of the criteria.
6. **Cost Control**: An important criterion for this evaluation. We will analyse which of the two mechanisms offer better a cost control mechanism for direct usage in terms of saving on Internet connection costs.

Criteria	One-Component Pricing Mechanism	Two-Component Pricing Mechanism
Pricing	**Low**: No Discounts, roaming charges extra. AT&T, Axxent and Bid2Bid: All have extra roaming charges	**High**: Customers pay two costs, an initial connection fee and an access cost. High discounts, rebate on total one month traffic cost. No roaming charges in local area.
Monitoring Traffic	**Low**: Does not give any privileges i.e. monitoring traffic. AT&T, Axxent & Bid2Bid: No provision to monitor traffic.	**High**: Proper monitoring of traffic is carried out on the Internet. (Connect, Australia)
Speed of Transmission	**Low**: Speed varies from period to period since congestion and traffic occur more frequently in one-component pricing. Sometimes high speed, sometimes low speed.	**High**: Speed is high due to T3, ADSL technology. Moreover users pay for proper high-speed access without congestion problems and exhaustive traffic.
Quality of Transmission	**Low**: Due to heavy congestion problems quality is lower, in terms of access, downloading, file transfer, messaging. Bid2Bid: Problem of cookies. Hampers the online auctions AT&T and Axxent: Due to lack of trafficking mechanisms and congestion handling, quality goes down.	**High**: No congestion and therefore high quality of service being offered. (Connects, Australia)
Congestion	**High**: Due to lack of monitoring traffic on the Internet. Users does not pay any extra and thus overgrazing of the Internet arena takes place due to scarcity of bandwidth. AT&T, Axxent & Bid2Bid: No provision to control traffic and congestion.	**Low**: Due to extra access cost users do not experience congestion on the Internet.
Cost Control	**Low**: Does not allow scope for saving on the Internet connection cost since it is a one-off payment.	**High**: Usage Based pricing offers and gives significant scope for saving on Internet connection costs.

Table 1: *Analysis of the One-Component Pricing Mechanism Versus the Two-Component Pricing Mechanism*

Critical Analysis

This evaluation gives the reader an idea about efficiency with respect to the two pricing mechanisms. It shows that the two-component pricing mechanism is more efficient than usage-based pricing in terms of the above criteria and as shown in the examples. In short the two pricing mechanism gives the user a better deal not only

in terms of money and cost but also in terms of deriving value from paying the access cost for sending and receiving bits and bytes. However, this is only one example from Australia which offers the usage-based pricing system to its customers.

There are examples in the real world, which state that companies still prefer to go for a flat rate rather than usage-based pricing. For example, apart from AT&T offering flat rate pricing, CompuServe, another Internet Service Provider and number 2 in the US, have introduced a flat rate pricing. Also big players like AOL suggests that flat rate pricing is changing Internet use patterns. Mansfield University Telecommunication announced the switch to flat rate pricing. However, the huge problem of using flat rate pricing for Internet access automatically poses questions regarding efficiency.

In one of the studies conducted by UC Berkeley, (Rafter 1999), Varian suggests that web surfers would be willing to pay more for a better connection. Varian, who was co-author of the study, commented that as faster connections become more widely available, it would make even more sense to offer usage-based pricing. This is particularly true for cable. Access speeds via cable vary with the number of people connected to any given network. The study found that people switch from one speed to another based on what they are doing online. On average, customers in the study group selected 3.5 out of five available speeds in a week. The researchers' initial conclusion was that the Internet Service Providers were missing out on a new revenue by offering dial-up customers flat rate static pricing.

The study reveals that two-component pricing which in this case is usage-based pricing is better placed to give efficient results in reducing the problems of congestion and high trafficking in the Internet to allow users unlimited access without congestion at any time during web browsing or any online activity such as web auctions, downloading files, transferring messages etc.

Economists have looked at pricing from a different perspective and with different set of tools. Gupta, Stahl and Whinston (1995) analysed the effectiveness of usage-based pricing. The work of Wang, Sirbu and Peha (1995) is also addressed in the notion of usage-based pricing for asynchronous transfer mode (ATM) networks. McKnight and Bailey (1995) suggest that with just flat rate pricing, the user's only choice is to change their behaviour by either sending/ receiving data. The implementation of usage-based pricing will increase the number of indicators users can give to their network provider in terms of what their demand and desires are. This will help the ISP to cater more for the customer in giving them a better quality service and thus they will be able to increase their customer base.

Looking at both sides, i.e. from the practical world to the world of academics, the use of a two- component pricing mechanism, in this case, usage-based pricing, will tend to increase efficiency and largely reduce the problem of Internet congestion.

5. Conclusions

We have examined the use of two pricing mechanisms to find out how efficient they are on the Internet. The two-component pricing mechanism, i.e. usage-based pricing, enhances the efficiency of the Internet in terms of congestion free traffic and reliable usage.

Through analysing the way the two-component pricing mechanism works it has been seen that the move towards usage-based pricing is a natural result of profit-seeking forces and thus contributes to economic efficiency and increases aggregate welfare (Varian & Mason 1993). The analysis and the evaluation have been carried out from the both seller's and buyer's perspective.

In a nutshell, there are two general ways to regulate usage of the network during congestion. One is to use technical mechanisms (such as TCP congestion controls) to limit behaviour. The other is to use pricing controls to charge the user for variation in behaviour. This paper concludes that it is desirable in the future to provide explicit mechanisms to allow users to specify different service needs, with the presumption that they will be differently priced. The two-component pricing mechanism is one such pricing structure (Crawford 1995) which does reflect user demand and prices are being charged accordingly. This is not only a pure price discrimination scheme (Varian 1993) but through this mechanism efficiency also increases from the seller's viewpoint and also from the buyer's viewpoint.

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