Congestion based Pricing

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Abstract

In this paper I first propose a congestion based pricing formed progress and also introduced price discrimination in telecom after that congestion pricing model at fixed internet and wireless network can be discussed. At last that mentioned the performance improvement given by the congestion-based pricing adaptive policy further improves as the network scales and more connections share resource.

Introduction

At modern communication networks, pricing for§ network services based on level of service, usage and congestion provides natural and equitable incentive for applications to adapt the sending rates according to the network conditions.

Traditional approaches to congestion control have viewed the Internet as a cooperative network. Transport protocols such as TCP were designed such that sources would adapt to network congestion by backing off and thus allow all sources to continue sending through the network, but at a reduced rate. Such congestion control is successful, however, only if users agree to cooperate in the manner mandated by the protocol designers. This has worked so far, perhaps because implementing a new transport protocol entails kernel programming that is slightly harder than viruswriting or other antisocial activities. In addition, some Internet service providers (ISPs) have forced their user traffic to conform to TCP-like behavior.

Price discrimination in telecom

Price discrimination means that different consumers are charged different prices for the same product. Firms give quantity discounts to both large and small customers; charge business and individuals different rates based on individual characteristics and usage pattern. Discriminatory pricing should be used whenever possible because it is always more profitable than uniform pricing. Differential pricing is common in industries with large fixed costs such as airlines, telecommunication, software, and semi-conduct. However, to apply this differential pricing is really complicated because it is really difficult to identify user groups. For instance, the long distance telecommunication market in the U.S. involves many different forms of differential pricing.

In this paper about congestion pricing will be introduced at fixed network and wireless network. Most Internet users already pay for access. In the United States, users typically pay a monthly subscription to their ISP — a flat-rate charge that gives them little incentive to react to congestion or to consider the costs of their actions. In contrast, many other countries, particularly in Europe, feature usage-

based pricing, where the price is related to the duration of the network connection. Such pricing plans can encourage users to disconnect from the Internet when they are not using it. In the future, users may also have the option of paying for different levels of service. In the Diffserv model, ISPs can offer customers a range of QoS classes. This lets them differentiate prices for users who are willing to pay extra for a higher QoS, even though performance in an unloaded network may differ little between the service levels. Such price discrimination maximizes the provider's profits and is common place in other industries, most notably airplane travel, where adjacent travelers have seldom paid the same price for their seats.

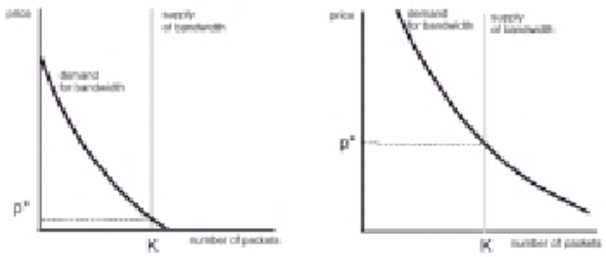
So where does congestion pricing fit into this framework? We know that charging network users for the congestion they cause can lead to more efficient network utilization by forcing them to take social costs into account. Yet this can seem counter-intuitive at first: Why should I be charged a congestion fee when I am actually receiving worse performance from the network and my ISP? In a congestion-pricing framework, however, the congestion charge would replace usage and QoS charges. Users would pay their ISPs a subscription charge to cover fixed costs, such as personnel and equipment and a congestion charge only when appropriate. This pricing scheme is feasible because, in the absence of congestion, the marginal cost of a network link is practically zeroed. Once the link is built, additional traffic costs little. Congestion pricing can also benefit network operators. By indicating the level of congestion and the user tolerance of it in their networks, congestion pricing can inform operators about when to reprovision and increase network capacity.

Telecommunication pricing Model

Network pricing strategies are divided mostly into two parts,

Static pricing and Dynamic pricing.

The static pricing usage is charged statistically regardless of the network situation. In static pricing methods, there are several methods like flat pricing, priority pricing and time of day pricing. The flat pricing methods is that users pay a sum to the network provider based on the amount of usage they used. Next, the priority pricing is charging a higher per byte fee for bytes with higher priority. The special pricing method is the time of day pricing. This is to accommodate peak and off-peak network periods. Usually telephone companies are using this pricing in long distance call during off-peak hours. When the people are calling in night, the operators provide the discount services. The charging rates of dynamic pricing are different depending on the network situation. The prices are going up when the demands of network are increasing. The next figures show such situation.



For instance, the transport auction pricing set the price dynamically in response to the changes of demand. Also, in the dynamic bandwidth allocation, the benefit function is introduced. The price is determined by the amount bandwidth that user will purchase in a given interval. In the Internet, to improve the quality of service, the differentiated services are discussed. It's a kind of priority service. Users are charged based on

the service classes that they use, i.e. a high class-quality (premium) service would be more expensive than a low-quality (best-effort) service. Another thing to consider is the quality of service under differentiated service. Users are free to choose the priorities for their traffic and service but are charged accordingly by the network. Take an example, when we use e-mail service, we don't need real time service. However, watching MPEG on the movie requires real-time service. Traffic services are divided into four categories, conventional, streaming, background and interactive. Depending on the service characteristics, the quality of services is differentiated. Depending on the user requirement bandwidth and QoS, The prices of wireless communication are varied. The economic rationale of price discrimination about the user requirement bandwidth and Differentiated service provides how the mobile operators make profits while it improves economic efficiency of radio resource. Discriminatory pricing should be used whenever possible because it is always more profitable than uniform pricing.

Actually in the network, pricing is purposed by two reasons. First, pricing generates revenue for the system. Second, it encourages players to use system resource more efficiently.

The major challenge in operation of wireless data communication is the efficiency of radio resources. In the wired network, the concept of congestion pricing has been introduced to improve the efficiency of the network resources. In the network, the real incremental cost of sending extra packet is almost zero. However, adding the data to the network has significantly different meaning in the aspect of social cost. When the network is not congested, the marginal cost is almost zero. In the case that the network is congested, the social cost of network resource is significantly positive. That is, if the user sends one additional packet into congested network, it will delay or interfere with other packet. Therefore, charging delay cost to user has been raised. Smart market pricing is the way that users attach value to each packet and summit. In un-congested situation, the price is 'zero'. However, at congestion, the network cost is the minimum value attached to a packet that went through the network. If a user wants to use network without delay or congestion, which has incentive to tell network his willingness to pay for the packet. When the user transmits data at high data rate, the higher power is required. It cause harm to the wireless network. It is possible that the network is congested when many users demand high data rate, which means they require high power level. In the wireless network, the study charging user by amount of power they are using and the harm they are causing, are needed. Congestion pricing by charging power can improve the efficient use of radio resource in mobile data service.

The Congestion Pricing

Actually all the congestion pricing schemes share one common element: the end users. It remains to be seen weather users will respond favorably to congestion pricing. The issue has been widely debated. In spite of its potential inefficiency, many users appear to favor flat-rate pricing.

Even if we assume those users will appreciate the benefits and accept congestion pricing, implementing a congestion pricing scheme still requires much work. To create the appropriate incentives, congestion pricing requires a competitive Internet market, such that users can easily select alternatives, for example by changing routes or ISPs. Otherwise, a malicious ISP could deliberately generate congestion on a monopolistically-provided link, forcing its users to pay a congestion charge and thereby increasing the ISP's

revenues. If users can avoid a congested link, they can defeat such a strategy. Although multihoming, where networks can choose to route between two or more upstream providers, has become a popular strategy for commercial networks, most end users currently have little control over the route their packets take. This situation is arguably becoming worse with the disappearance of the so-called "free" ISPs that charge only for telephone calls. Such ISPs facilitate user switching between access ISPs, since there are no contracts and little cost to changing ISP. Broadband connections such as cable modems and DSL lines, however, often entail long-term contracts that inhibit this switching.

Many congestion pricing schemes assume a small number of long-term congested bottlenecks. While this might apply to relatively predictable road or telephone networks, Internet congestion is different. Most Internet congestion is unpredictable and can occur almost instantly at a popular site — such as the so-called "slashdot effect," named after the popular Web site that can generate huge increases in traffic to sites referenced in its news stories. Such congestion spikes could lead to highly unpredictable congestion prices.

Conclusion:

If the price does not depend on the congestion conditions in the network, customers with less bandwidth-sensitive applications have no motivation to reduce their traffic as network congestion increases. As a result, either the service request blocking rate will increase sharply at the call admission control level, or the packet dropping rate will increase greatly at the queue management level. Having a congestion-dependent component in the service price provides a monetary incentive for adaptive applications to adapt their service class and/or sending rates according to network conditions. In periods of resource scarcity, quality sensitive applications can maintain their resource levels by paying more, and relatively quality-insensitive applications will reduce their sending rates or change to a lower class of service.

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