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The effects of network neutrality on the diffusion of new Internet application services

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ABSTRACT

The debate over network neutrality started with the appearance of new Internet application services that are latency sensitive and the use of broad bandwidth. These services are still diffusing, and more applications that use broader bandwidth with greater latency sensitivity are expected to be developed. To estimate precisely the effect of network neutrality regulation, it is necessary to forecast the number of end-users that will adopt application services. However, previous studies are limited in that they assume that the potential market and the final number of adopters are constant at the current market penetration level. By computational experiments, this research estimates the effect of network neutrality regulation considering the diffusion process of application services such as IPTV and VoIP. Additionally, it deduces the relation between the effect of network neutrality regulation and the level of diffusion of new Internet application services.

1. Introduction

The network neutrality debate started when Madison River Communications, a small telecommunications company in North Carolina, blocked their DSL end-users from using the voice over Internet protocol (VoIP) service of Vonage in 2004 (Herman, 2006). Even in South Korea, which developed an extensive broadband network since 2000, subscribers of LG PowerCom were not allowed to use Hana TV service, a kind of pre-Internet protocol TV (IPTV) service, because LG PowerCom discarded Hana TV's service packets (Wallsten and Hausladen, 2009). Not only in the United States and South Korea,[1] but also all around the world, network neutrality is a sensitive issue since the development of VoIP and IPTV services.

The debate over network neutrality, which did not exist before, started with the introduction of next generation access network and the entrance of new Internet application services such as VoIP and IPTV. Most of the newly developed services use more bandwidth and are more sensitive to latency than earlier application services (Frischmann and van Schewick, 2007). Nevertheless, Internet protocol (IP) cannot distinguish latency sensitive applications from latency insensitive applications because of its basic principle of "best effort." Therefore, the role of Internet service providers (ISPs) that are responsible for quality of service (QoS) has expanded (Wu, 2003) to allow for others to use the network, and to control and manage the network to operate well. Moreover, a wide and stable network is the most important determinant of the quality of newly developed Internet application services that use wide bandwidth and are latency sensitive[2]. Therefore, the role and market power of ISPs are increasing, and ISPs are attempting to profit from their market power. With the expectation of forthcoming

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[1] See Shin and Han (2012). They reviewed network neutrality policy in Korea.

[2] Every Application that requires QoS does not necessarily require high bandwidth. VoIP is an example. It is true, however, that newly developed Internet application services tend to require high bandwidth (Frischmann and van Schewick, 2007).

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application services that will use a wider bandwidth and be more latency sensitive, the market power of ISPs will increase and the debate over network neutrality will continue.

For this reason, a large number of studies have been done related to network neutrality, and both proponents and opponents exist at present. For instance, Speta (2000a) and Speta (2000b) claim that ISPs have no incentive to discriminate against content providers (CPs) or application service providers (ASPs). Conversely, most proponents dismiss this assertion under the assumption that discrimination will occur (For instance, see Wu (2003), van Schewick (2007), Kocsis and de Bijl (2007), and Crowcroft (2007)), and Lee and Hwang (2011) show that there is no evidence that ISPs discriminate against ASPs using empirical data. In addition, Krämer et al. (2012) explain the origin of network neutrality debate with the history of the Internet development and summarize recent network neutrality literature for and against network neutrality regulation. The authors propose a policy decision process considering QoS, two-sided pricing, and managed network.

However, no research has been conducted regarding the diffusion of new Internet application services, even though the network neutrality debate commenced with the appearance of these new services. To estimate precisely the effect of network neutrality regulation, it is necessary to forecast the number of end-users that will adopt application services. However, previous studies are limited in that they assume that the market potential and final number of adopters is constant at the current market penetration level. For instance, if network neutrality regulation lowers the final number of adopters, the surplus which end-users can achieve and the profit that application service providers can have will be lowered as well. Therefore, the effect of the regulation will be worse than the level expected by network neutrality proponents because they did not count the decrement of the final number of adopters caused by network neutrality regulation. On the contrary, if regulation increases the final number of adopters, it may increase the profits of ISPs and ASPs against the expectations of network neutrality opponents.

Moreover, the effect of network neutrality regulation changes according to the level of diffusion with respect to the number of current adopters. If the diffusion of a service is almost complete, the word-of-mouth effect in diffusion theory (Rogers, 2003) must be exceedingly large for network neutrality regulation to affect the diffusion of application services; therefore, the effect of the regulation could be overestimated if the level of diffusion is not considered. In contrast, if the number of current adopters is not far from the initial level of diffusion, the effect of the regulation is larger than expected. Some studies (e.g., Kocsis and de Bijl, 2007) oppose preliminary regulations because of the fear that government may unsuccessfully introduce network neutrality regulation when the characteristics of information and communications technology (ICT) industry are considered. However, one must acknowledge that this industry cannot be recovered easily once fair competition no longer exists (Black, 2002), especially in high tech markets in which the initial stage of the product is very important (Moore, 2002). In conclusion, the effect of network neutrality regulation changes depending on the level of diffusion of application services.

Accordingly, this research estimates the effect of network neutrality regulation, considering the diffusion process of current application services. Specifically, it focuses whether ISPs have incentives to discriminate among different ASPs when the government does not regulate ISPs through the network neutrality principle. Additionally, it deduces the relation between the effect of network neutrality regulation and the level of diffusion of application services. For these purposes, this research shows the path of diffusion in a virtually created "small world" (Watts and Strogatz, 1998) using computational experiments under the assumption of the introduction of new Internet application services.

The remainder of this paper is organized as follows. The following section introduces the component of the social network in which the new Internet application service diffuses. Section 3 shows the process of diffusion introduced in Section 2, and the change in consumer utility according to the existence of network neutrality regulation. In Section 4, the simulation scenarios are explained based on the model in Section 3. The results of the simulation are included in Section 5. Finally, Section 6 concludes with the policy implications of the results.

2. Networks for Social Systems

When a firm develops a new service, attaining early market share is critical to determine the success of the service (Moore, 2002). For this reason, Beard and Easingwood (1996) introduce some strategies to gain early market share, and Song and Parry (2009) refer to effective strategies that marketers should develop for consumers to expose the "search attributes." Rogers (2003) regards innovators as entities that adopt earlier in the market. After the introduction of innovators, the service is then diffused through various communication channels. This diffusion process is delivered to the other social members through mass media or private relationships (Rogers, 2003).

However, the final number of adopters or speed of diffusion depends on the characteristics of the social network (Rogers, 2003). These are critical factors in determining the patterns of diffusion. The configuration and the relative strength of the networks among social members are important standards not only in predicting the diffusion patterns, but estimating the speed of diffusion (Deroïan, 2002). This section, therefore, covers the social system, namely the configuration and characteristics of the network entities in which a new service is diffused.[3] In particular, this study uses simply actors, relations, and networks, some of the fundamental components of a social network, as Wasserman and Faust (1994) state. These are required

[3] Many researchers have investigated theoretically and empirically on forecasting the diffusion of service based on the social network approaches. For example, see Kiss and Bichler (2008).