

Network Non-Neutrality on the Internet: Content Provision Under a Subscription Revenue Model

[Poster]

Mohammad Hassan Lotfi
ESE Department
University of Pennsylvania
Philadelphia, PA, 19104
lotfm@seas.upenn.edu

George Kesidis
EE and CS& E Department
Pennsylvania State University
University Park, PA, 16803
kesidis@engr.psu.edu

Saswati Sarkar
ESE Department
University of Pennsylvania
Philadelphia, PA, 19104
swati@seas.upenn.edu

Net neutrality on the Internet is perceived as the policy that mandates Internet Service Providers (ISPs) to treat all data equally, regardless of the source, destination, and type of the data. Recently, the net-neutrality debate has received more attention, since in January 2014, a federal appeals court struck down some parts of the Federal Communication Commission's rules for Net-Neutrality.

However, changing the balance of the Internet market by ISPs and switching to a non-neutral regime may eventually lead to a battle between ISPs and Content Providers (CPs). Depending on their power over the market, the winner could be any of the two. For instance, one can think about scenarios that ISPs end up paying a popular CP to have the privilege of carrying its data. The goal of this paper is to model the interaction between ISPs and CPs in a non-neutral regime.

Most of the literature about the Net Neutrality debate fall into the realm of law and policy making. A survey of the existing scarce literature on economics analysis of the net-neutrality debate is presented in [1]. In this genre of work, the social welfare analysis of the neutral and non-neutral regime has been taken into account largely, while the results and conclusions vary to a great extent depending on the model used.

The goal of this paper is to provide an insight into the equilibrium of the Internet market, when the current balance of the market is disrupted, and one of the ISPs switches to a non-neutral regime. We cast the problem with a two-sided market framework which captures the Internet market appropriately. In addition, the problem is modelled as a sequential game. Two Internet Service Providers (ISPs) are considered that act as platforms that connect the two sides of the Internet market: a Content Provider (CP) that charges end-users with a subscription fee and a continuum of end-users.

In our model, the CP should pay a per-subscriber fee to the non-neutral ISP in order to access the ISP's subscribers. In addition, the CP is also non-neutral, in the sense that she can potentially charge users of different ISPs with different subscription fees. This is what we call the "*leverage*" of the CP over end-users and subsequently ISPs, by which the CP can control the equilibrium of the market.

We model the valuation of end-users for ISPs and CP using a hotelling model. We assume that the neutral ISP is located at 0, the non-neutral one is located at 1, and end-

users are distributed uniformly along the unit interval, $[0, 1]$. In modelling the valuation of end-users for ISPs, a transport cost is considered to capture the inertia of end-users to change their current ISP due to their high budget and their prior experience with the ISP. In other words, wealthier users with high budget are less sensitive to the price they pay, more reluctant to change their ISP, and subsequently located near one of the ISPs depending on their prior experience with ISPs. Thus these users have higher valuation for connecting to the Internet via the closest ISP. In addition, we assume that the valuation of a user for content of G increases by her budget. In other words, the less sensitive a user to the price, the higher the chance of buying the content from G. Thus, the closer an end-user to one of the two ISPs, i.e. points 0 or 1 on the unit interval, the higher the valuation of the user for CP G. We assume full market coverage by ISPs and the CP.

We use the standard two-sided market framework used in the context of the Internet market in [2], and seek the subgame perfect equilibrium of the sequential game using backward induction. Results reveal that the CP is able to control the non-neutral ISP to some extent. However, switching to a non-neutral regime by an ISP tips the balance of the market in favor of this ISP.

In equilibrium, subscription fees are determined by the CP such that the non-neutral ISP cannot strictly increase her payoff by charging the CP a very high price. This is the result of the leverage of the CP over ISPs and end-users. In addition, the non-neutral ISP attracts more end-users since this ISP subsidizes end-users with the money that she collects from the CP. In addition, knowing that only users who are less sensitive to price (have high budgets) stay with the neutral ISP, the CP compensates what she pays to the non-neutral ISP by charging users of the neutral ISP a higher price. This increases the differentiation between platforms, and makes the non-neutral ISP more favorable for end-users.

The results of this model are dependent on the assumption of the full market coverage by G, since this assumption may reduce the strength of the leverage of G. A direction for future works is to investigate the market equilibrium when G is not restricted to cover the end-user market.

1. REFERENCES

- [1] F. Schuett. "Network neutrality: A survey of the economic literature.", *Review of Network Economics* 9.2 (2010).
- [2] N. Economides and J. Tag. "Network neutrality on the Internet: A two-sided market analysis.", *Information Economics and Policy* 24.2 (2012): 91-104.