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# International Journal of Industrial Organization

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## Net neutrality and inflation of traffic<sup>☆</sup>

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### ARTICLE INFO

#### Article history:

Received 10 April 2015

Revised 17 March 2016

Accepted 21 March 2016

Available online 4 April 2016

#### JEL classifications:

L12

L51

L86

### ABSTRACT

Under strict net neutrality Internet service providers (ISPs) are required to carry data without any differentiation and at no cost to the content provider. We provide a simple framework with a monopoly ISP to evaluate the short-run effects of different net neutrality rules. Content differs in its sensitivity to delay. Content providers can use congestion control techniques to reduce delay for their content, but do not take into account the effect of their decisions on the aggregate volume of traffic. As a result, strict net neutrality often leads to socially inefficient allocation of traffic and traffic inflation. We show

<sup>☆</sup> We thank the Co-editor Giacomo Calzolari, two anonymous reviewers, Cédric Argenton, Jan Boone, Marc Bourreau, Joan Calzada, Dennis Gärtner, Axel Gautier, Dominik Grafenhofer, Martin Hellwig, Byung-Cheol Kim, Viktoria Kocsis, Jan Krämer, Jens Prüfer, Markus Reisinger, Jörg Werner, Bert Willems, Gijsbert Zwart, seminar participants at the Frankfurt School of Finance, the Max Planck Institute for Research on Collective Goods (Bonn), the University of Florence, the University of Liège, and Tilburg University, as well as participants at the 2013 “Economics of ICT”-conference in Mannheim, the 2014 “Economics of ICT”-conference in Paris, the 2014 Workshop on “Economics of ICT” in Porto, the 2014 Florence School of Regulation Scientific Seminar on “Media and Telecommunications” in Florence, the 2014 International Industrial Organization Conference (IIOC) in Chicago, the 2014 “Jornadas de Economia Industrial” in Barcelona, the Symposium in honor of Jean Tirole in The Hague, and the 2015 Conference of the Canadian Economics Association in Toronto for helpful comments. Martin Peitz gratefully acknowledges financial support from the [Deutsche Forschungsgemeinschaft](#) (project PE 813/2-2).

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*Keywords:*

Net neutrality  
Network congestion  
Telecommunications  
Quality of service

that piece-meal departures from net neutrality, such as transmission fees or prioritization based on sensitivity to delay, do not necessarily improve efficiency. However, the ISP implements the efficient allocation when allowed to introduce bandwidth tiering and charge for prioritized delivery.

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## 1. Introduction

The net neutrality debate has focused on the question whether users' ISPs are allowed to prioritize certain types of services, and to charge content providers for the delivery of traffic, possibly dependent on the type of content and the priority which is assigned to the data packets. The debate within economics has focused on allocative consequences of various net neutrality rules. Apart from vertical foreclosure concerns, possible inefficiencies in the regulated or unregulated market may be due to market power, external effects between content providers and users, as well as negative external effects arising from congestion in the network. The present paper adds to this debate by studying the incentives of content providers to affect traffic volumes. We propose a stylized setting with a monopoly ISP and two groups of content providers: some content providers offer content whose quality suffers if delivery is delayed, while others offer content whose quality is not sensitive to delay.

Strict net neutrality in our setting means that all incoming traffic is treated equally by the ISP and content providers are not charged for delivery of traffic. We show that, under some conditions, taking investment decisions of ISPs and content providers as given, strict net neutrality leads to a loss in social welfare compared to the first best and even the second best in which the planner treats all traffic equal. Inefficiencies arise because of traffic inflation and an inefficient allocation of capacity to different types of content. By contrast, the first best is implemented in a regime with bandwidth tiering. Bandwidth tiering leads to prioritized delivery of time-sensitive content and is always welfare-superior to strict net neutrality. However, the welfare effects of piece-meal departures from net neutrality, namely uniform transmission fees and the prioritization of time-sensitive content, are ambiguous.

Our analysis is motivated by three observations. First, there are congestion issues on the Internet. The increase in high-bandwidth applications and content, combined with limited middle-mile and last-mile capacity, results in congestion during peak hours, leading to delay (see, e.g., [Roy and Feamster, 2013](#)). This issue is of particular importance on mobile networks. Second, some content is more sensitive to delay than other content. Time-sensitive content includes voice and video telephony, online games, real-time video streaming, and certain cloud services; less time-sensitive content includes email, web browsing, and file sharing, where modest delays in transmission do not matter much. Third, and most importantly, certain techniques used to minimize delay – so called *congestion control techniques* – affect the volume of traffic on the network. Some of them

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