

# Net Neutrality, Foreclosure and the Fast Lane

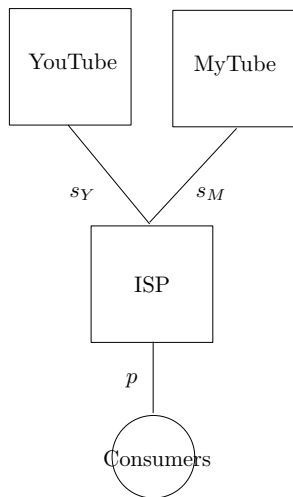
## An empirical study of the UK

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NET Institute conference  
Berkeley, June 7 2013

# Net neutrality: definition

ISPs cannot distinguish between data packets transmitted over the network.



Implications:

- **Zero price rule**  
ISP cannot charge CP  
(No termination fees)
- **Non-discrimination rule**  
ISP cannot change speed of some CPs  
(No quality degradation / **foreclosure**)
- **Combination of both rules**  
ISP cannot offer a menu of qualities  
(No **fast lane**)

# Research question

- ISPs might want to **differentiate speeds** among content providers
  - ▶ to sell a “fast lane”
  - ▶ to **foreclose** competitors of its own content
- Consumers will change **content choices** and re-optimize **ISP choice**

## Research question

Does an ISP have an incentive to abandon net neutrality? And what are the effects on CP and consumers?

## Strategy

- ① Identify how much consumers
  - ▶ care about speed in the consumption of online content
  - ▶ take into account utility from consuming content when choosing an ISP
- ② Change speeds and see what happens to content and ISP choices

# Motivation: Fast lane

**THE WALL STREET JOURNAL**

WSJ.com

TECHNOLOGY | December 15, 2008

## Google Wants Its Own Fast Track on the Web

By VISHESH KUMAR and CHRISTOPHER RHOADS

The celebrated openness of the Internet -- network providers are not supposed to give preferential treatment to any traffic -- is quietly losing powerful defenders.

[Google](#) Inc. has approached major cable and phone companies that carry Internet traffic with a proposal to create a fast lane for its own content, according to documents reviewed by The Wall Street Journal. Google has traditionally been one of the loudest advocates of equal network access for all content providers.

At risk is a principle known as network neutrality: Cable and phone companies that operate the data pipelines are supposed to treat all traffic the same -- nobody is supposed to jump the line.

Krishnan & Sitaraman (2012) show that poor video performance at a site causes viewers to [abandon videos more often](#), [view videos for a lesser time](#), and [return to the same site less frequently](#).

# Policy: FCC report 10-201, December 2010

## II THE NEED FOR OPEN INTERNET PROTECTIONS

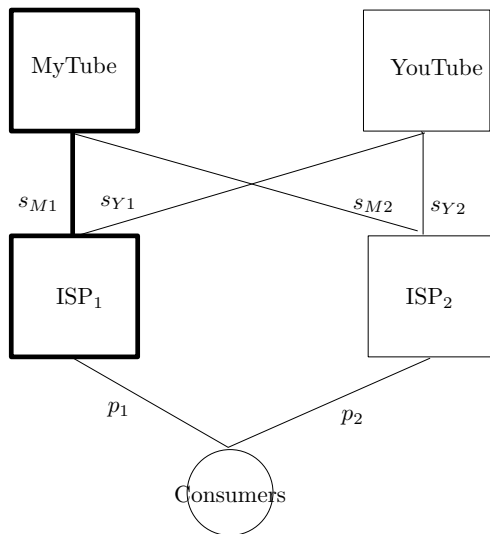
### **B Broadband Providers Have the Incentive and Ability to Limit Internet Openness.**

- ▶ *“Broadband providers have incentives to **interfere** with the operation of third-party Internet-based **services that compete with the providers** revenue-generating telephony and/or pay-television **services**.”*
- ▶ *“Broadband providers may have incentives to increase revenues by **charging edge providers**, who already pay for their own connections to the Internet, for **access or prioritized access to end users**.”*

### **C Broadband Providers Have Acted to Limit Openness.**

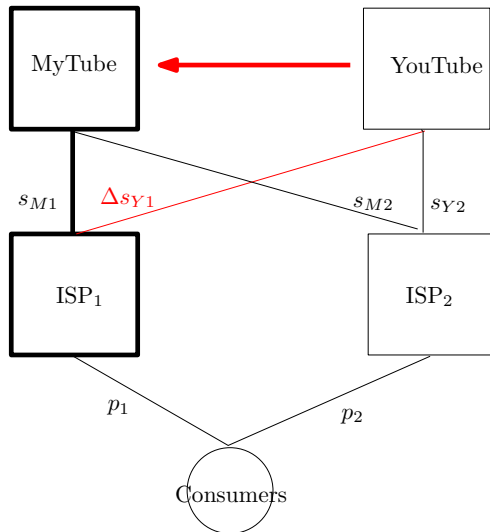
# Preview

Current situation



# Preview of counterfactual

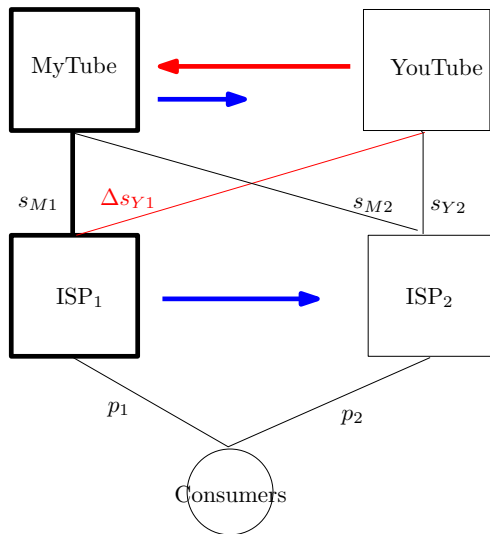
Change at constant downstream choices



# Preview of counterfactual

Change at constant downstream choices

Change at new downstream choices





# Literature on Net Neutrality

- Zero-price rule / no termination fees: Lee and Wu (2009), Economides and Tåg (2011), Musacchio, Schwartz and Walrand (2009)
- Non-discrimination rule
  - ▶ Degradation of quality / vertical foreclosure: Chen and Nalebuff (2006)
  - ▶ Menu of qualities / second degree price discrimination: Hermalin and Katz (2007), Choi and Kim (2012), Cheng, Bandyopadhyay and Guo (2012), Kramer and Wiewiorra (2010), Economides and Hermalin (2012)

# Data: 3 sources

## UK, 2009

- **Household level data:** demographics, internet usage, ISP choices and online content consumption for 6000 households (from Ofcom)
- **Market level data:** broadband penetration rates and subscribers by ISP and by Local Exchange (from Nardotto et al, 2012)
- **Product level data:** prices, speeds, data caps,... by broadband package (from The Internet Archive)

## Summary statistics: content choices

Online content	Speed < 8Mb/s	Speed ≥ 8Mb/s
Playing games	0.39	0.45
Purchasing goods/services	0.73	0.78
Banking	0.58	0.62
Gambling/trading/auctions	0.19	0.24
E-mail	0.85	0.88
IM, chat, voice calls	0.38	0.44
General surfing/browsing	0.84	0.83
Information for work/business	0.44	0.46
Information for school	0.34	0.37
Information for personal reasons	0.59	0.55
Download music or movies	0.39	0.46
Watch live TV programmes	0.19	0.21
Watch catch-up TV (Skyplayer)	0.26	0.27
Listen to radio	0.22	0.21
Watch news programmes	0.16	0.17
Watch video clips (YouTube)	0.37	0.39
Social networking sites	0.44	0.51
Upload content	0.19	0.26
None of these	0.02	0.01
Average number of chosen contents	7.6	8.1
Number of households	710	1004

# Product characteristics: example Sky

	WITHIN THE SKY BROADBAND NETWORK AREA			OUTSIDE AREA
	Base	Mid	Max	Connect
Monthly Cost (with Sky Talk)	<b>FREE*</b>	<b>£5*</b>	<b>£10*</b>	<b>£17</b>
Monthly Cost (without Sky Talk from 1.3.09)	<b>£5</b>	<b>£10</b>	<b>£15</b>	<b>£17</b>
Maximum Download Speed <sup>1</sup>	<b>2Mb</b>	<b>8Mb</b>	<b>16Mb</b>	<b>8Mb</b>
Upload Speed <sup>1</sup>	<b>400Kb</b>	<b>400Kb</b>	<b>768Kb</b>	<b>448Kb</b>
Monthly Usage Allowance	<b>2GB</b>	<b>40GB</b>	<b>Truly unlimited</b>	<b>40GB</b>
Ideal For	Browsing and emailing	Everyday essential browsing and downloading	Great for the whole family	Everyday essential browsing and downloading

## Summary statistics: local competition

	<b>Number</b>	<b>% of LE</b>	<b>% of HH</b>
Total LEs	5,587	-	-
LLU enabled	2,032	36	85

### **By number of players**

Monopoly	3,570	64	15
Duopoly	445	8	6
Triopoly	211	4	5
4 players	206	4	6
5 players	248	4	10
6 players	295	5	14
7 players	612	11	43

## Content choice

Consumer  $i$ 's utility of consuming content  $k$  through ISP  $j$ :

$$u_{ijk} = \gamma_k^0 + \gamma_k^1 s_{jk} + \gamma_k^2 \mathbf{D}_i$$

Utility of choosing combination  $c$  of multiple contents:

$$u_{ijc} = \sum_{k \in c} u_{ijk} + \epsilon^U$$

Probability of choosing combination  $c$ :

$$P_{ijc} = \frac{\exp(u_{ijc})}{\sum_{d \in S_i} \exp(u_{ijd})}$$

Utility of content through ISP  $j$ :

$$u_{ij}^* = \sum_c P_{ijc} u_{ijc}$$

## ISP choice

Consumer  $i$ 's utility of choosing broadband pack  $j$ :

$$v_{ij} = u_{ij}^* + \alpha p_j + X_j' \beta + \delta_{ISP} + \epsilon_{ij}$$

Probability of choosing broadband pack  $j$ :

$$P_{ij} = \frac{\exp(u_{ijc}^* + \alpha p_j + X_j' \beta + \delta_{ISP})}{1 + \sum_l \exp(u_{ilc}^* + \alpha p_l + X_l' \beta + \delta_{ISP})}$$

Market share of broadband pack  $j$ :

$$s_j = \frac{1}{M} \sum_i^M P_{ij}$$

# Estimation

- Joint estimation of content choice and ISP choice
- Using two different subsamples of the data set

⇒ transform likelihoods into moment conditions

Moments relating to content choice:

$$\sum_i \sum_c [d_{ijc} - P_{ijc}(\gamma)] X_{ijc} = 0$$

Moments relating to ISP choice:

$$\sum_i \sum_j [d_{ij} - P_{ij}(\theta)] X_{ij} = 0$$



## Results: content choice (video content)

	Mean	Interactions with demographics			
		Age	Kids	Married	Employed
Download	4.57 (0.40)	-0.56 (0.03)	0.05 (0.03)	-0.02 (0.04)	0.11 (0.04)
Live TV	2.27 (0.40)	-0.10 (0.03)	0.05 (0.04)	-0.04 (0.05)	0.11 (0.04)
Video clips	4.32 (0.41)	-0.55 (0.03)	0.29 (0.03)	-0.45 (0.04)	0.19 (0.04)
Catch-up TV	2.96 (0.41)	0.01 (0.03)	-0.25 (0.04)	-0.08 (0.04)	-0.25 (0.04)
Radio	1.61 (0.41)	0.32 (0.04)	-0.23 (0.04)	-0.40 (0.04)	0.60 (0.04)
News clips	1.33 (0.41)	0.35 (0.04)	-0.64 (0.05)	0.06 (0.05)	0.23 (0.05)
Speed	1.62 (0.6)				

## Results: ISP choice

	<b>Coef.</b>	<b>Std. Err.</b>
Content utility	0.24	0.01
Price	-0.93	0.02
Data cap	-0.27	0.11
AOL	-1.85	0.17
Orange	-1.70	0.15
Sky	-0.32	0.05
TalkTalk	0.21	0.07
Tiscali	0.05	0.13
Virgin	0.14	0.11

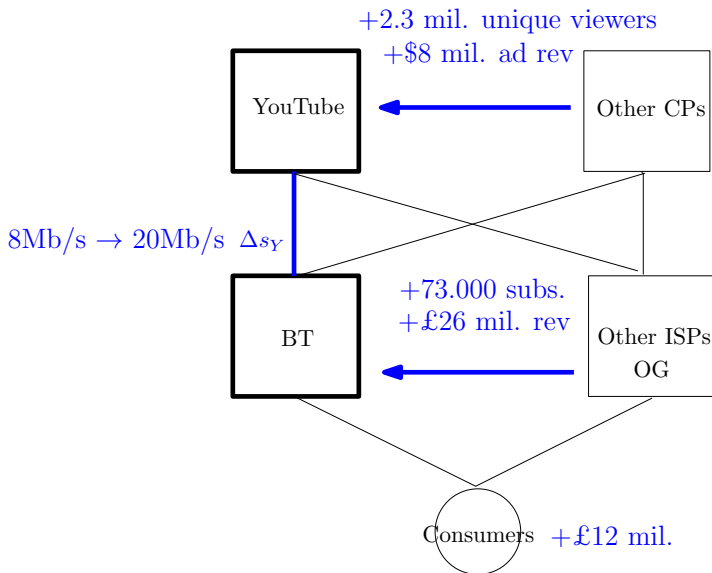
- price elasticity: -2.6

## Counterfactual 1: fast lane

How much would YouTube be willing to pay for a fast lane?

- At most the increase in advertising revenue.
- Model will predict increase in unique visitors.
- Each unique visitor watched  $\sim 100$  videos a month in the UK in 2009.
- YouTube revenue per 1000 ads = \$2.4 - \$2.8 in UK in 2009.

## Counterfactual 1: fast lane for YouTube

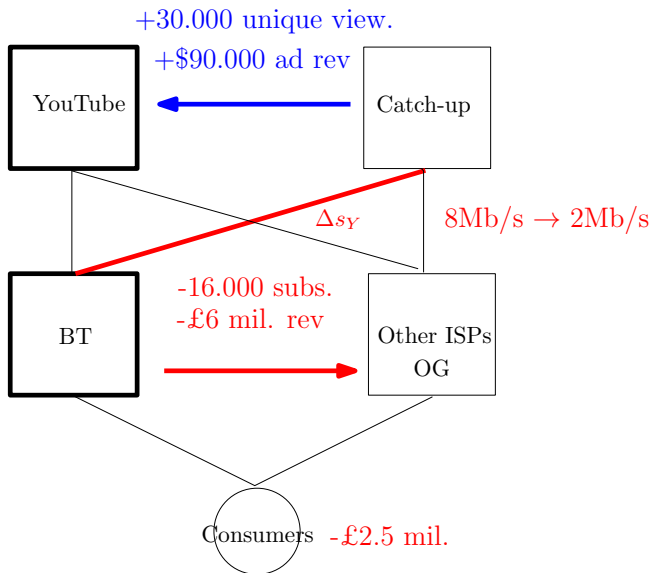


## Counterfactual 2: foreclosure through quality degradation

Would a dominant ISP find it **profitable** to **foreclose content** that competes with its own (associated) content?

- Imagine an agreement between BT and YouTube to foreclose other video content.
- Second biggest provider of online videos is **catch-up TV** (BBC, Channel4, iTV, Sky)

## Counterfactual 2: foreclosure of catch-up TV



## Other counterfactuals possible with this model

- What if BT combines a fast lane with foreclosure?
- What if YouTube gets a fast lane at all ISPs?
- What if an entrant with a better product than YouTube is foreclosed?
- ...

## Preliminary conclusion

- Fast lane: seems profitable and beneficial to CS.
- Foreclosure through quality degradation: seems unlikely.

Net neutrality regulation does not seem necessary at the moment.  
However, what are the LR effects on investment and content innovation?