

Computational Analysis of Practices that Threaten Network Neutrality in a Duopolistic Next-Generation Network Market

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Outline

- Competition models
- Beltrán-Sharkey 2008 model
- Implications for network neutrality

Competition models

COMPETITION MODELS

Background

- Paul de Bijl and Martin Peitz (2003) did a study for the Netherlands regulator (OPTA) whose central question was:
*How should one **design** policy and regulation with the purpose of stimulating competition in markets for fixed voice telephony, while ensuring that consumers **benefit from entry**, and operators have sufficient **incentives** to be active on the market?*
- Study used applied game theory and computer simulation to understand evolution of key market indicators.
- Focused on competition between two network operators who compete for subscribers by setting subscription prices and usage prices for voice service
- Political economy of regulation
How do access prices and other regulatory tools affect both consumers' surplus and profits of network operators?

Two-Sided Platform Competition

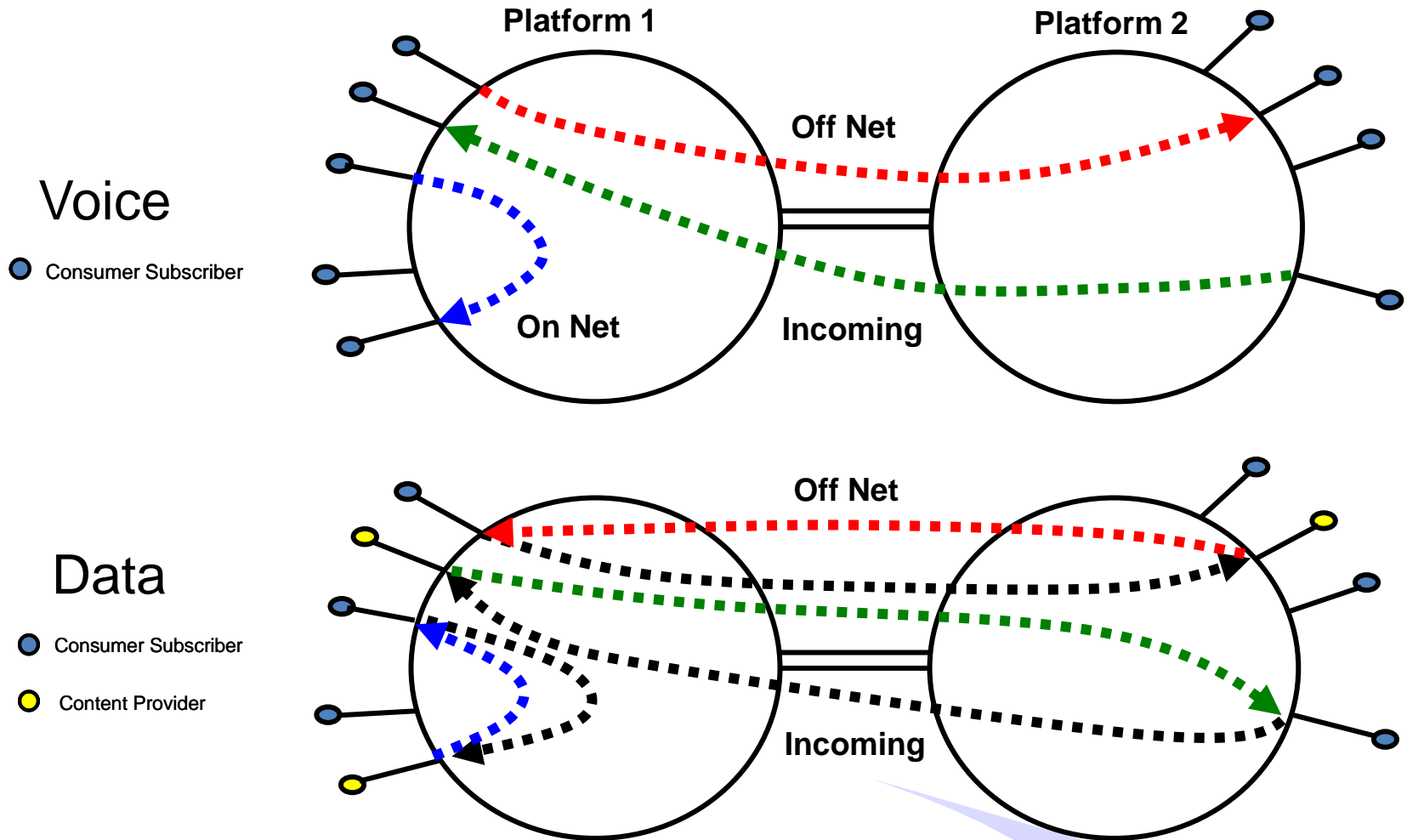
- We extend the de Bijl and Peitz model.
- Operators are considered (two-sided)* platforms competing for both individual customers and content providers who provide voice and data services.
- We address all of the issues of concern to de Bijl and Peitz and additional issues relevant to Next Generation Networks
 - Network neutrality
 - Peering versus transit

(*) Tirole, J. and J.C. Rochet, 2004, Two-sided markets: an overview

Beltrán-Sharkey 2008 model

BELTRÁN-SHARKEY 2008 MODEL

Voice and Data Traffic Patterns



Beltran, F. and W.W. Sharkey, 2008, "A Dynamic Model of Next-Generation Networks with Two-Sided Platform Competition", TPRC 2008.

The Model: Consumers

- Consumer subscribers derive utility from both voice calls to other subscribers (on-net and off-net) and from access to data services (on-net and off-net)
- For voice calls, only the originating caller is charged
- For data transactions, the originating consumer determines the quantity of transactions, though potentially both consumers and content providers can be charged a usage fee
- Individual consumers face a subscription charge

The Model: Externalities

- Consumer utility and content provider profits are allowed to depend on market externality factors
 - Consumers value joining a network with many other consumers (traditional externality factor)
 - Consumers value joining a network with many content providers (e.g. due to higher quality data transmission)
 - Content providers value joining a network with many consumers (e.g. better access to ancillary data services)
 - Content providers may negatively value joining a network with many other content providers due to competition

The Model: Content Providers

- The content market is assumed to be competitive with an increasing marginal cost supply function
- Content providers earn profits based on advertising revenues
 - Advertising revenues are assumed to be a fixed percentage of consumer surplus
- Total content supply is a function of total advertising revenue minus usage fees imposed by platform operators
 - Consumer demand for data transactions depends on the level of content as well as usage fees imposed by platforms
- Platform operators may or may not be able to charge content providers fixed and usage fees, based on institutional or regulatory constraints

State variables

Platforms provide services to both content providers and end-users, charging them prices in accordance to the following notation (for i or $j = 1, 2$)

- p_{ij} = price to consumers of platform i for voice traffic with another consumer on platform j
- q_{ij} = price to consumers of platform i for data traffic with a content provider on platform j
- r_{ij} = price to content providers on platform i for data traffic with a consumer on platform j
- m_i = subscription price for consumers on platform i
- n_i = subscription price for content providers on platform i

The Model: Platform Equilibrium

- Platforms compete as a duopoly. Initial market shares are arbitrarily set
- Both platform operators choose usage and subscription prices (where allowed) in each period to maximize profits
- Consumers and content providers respond to these prices by choosing a platform to subscribe to
- Both consumers and providers are assumed to switch platforms only if the increase in consumer surplus or provider profit exceeds a critical value
- Market shares in the following period depend on end user and content provider platform decisions

Implications for network neutrality

IMPLICATIONS FOR NETWORK NEUTRALITY

Results

- Determinants of entry or exit
 - Intensity of competition
 - Rate structure
- Wholesale pricing of network termination
 - Voice termination charges
 - Peering and transit for data services
- Network neutrality
 - Content blocking
 - Usage fees for content providers

Representative Outputs for a Base Case with Default Inputs

Competitive Intensity	Customer Demand	Marginal Costs
$Z_C = 7500$	$aVoice = 10$	$c_{11} = c_{21} = 1$
$Z_P = 3000$	$bVoice = 0.02$	$c_{12} = c_{22} = 1$
Network Externality	$aData = 8$	$d_{11} = d_{21} = 2$
$ConsumerFixedUtility = 5000$	$bData = 0.02$	$d_{12} = d_{22} = 2$
$ProviderFixedUtility = 5000$	Content Provider Supply	Fixed Charges
$C_{X1} = 0.3 \quad C_{X2} = 0.2$	$ProviderVariableCost = 500$	$f_C = 2000$
$P_{X1} = 0.2 \quad P_{X2} = 0.1$	$ProviderFixedCost = 1000$	$f_P = 0$
Initial Market Shares	$AdRevMultiplier = 1$	Access Charges
$\alpha_1(0) = 0.9$	Discount Rate per Period	$ta_{1Voice} = ta_{2Voice} = 2$
$\beta_1(0) = 0.9$	$\delta = 0.976$	$ta_{1Data} = ta_{2Data} = 0$

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Net Neutrality Issues: Content Blocking

- Blocking of content unambiguously lowers total surplus

	Total Surplus	Consumer Surplus	Provider Profit	Platform Profit
Ramsey Solution (Default Inputs)	13391	5926	7465	0
Open Platform (Default Inputs)	13112	2859	3584	6669
Blocked Content (Default Inputs)	11911	1306	4987	5617

Usage Fees for Content

- Under default input assumptions, usage fees close to zero maximize total surplus

Content Provider Usage Fees	Total Surplus	Consumer Surplus	Provider Profit	Platform Profit	Final Period Content
3.00	10870	2898	3514	4458	0.8
2.00	12341	4623	3899	3820	1.75
1.00	13066	4274	3848	4944	2.40
0.00	13112	2859	3584	6669	2.75
-1.00	12601	1164	3274	8163	2.80
-2.00	11715	-242	3028	8929	2.55
-3.00	10690	-1012	2901	8801	2.00

Optimal Usage Fees for Content as Profitability of Content Market Varies

AdRev Multiplier	Regulated Duopoly or Monopoly			Competitive Duopoly		
	q*	r*	TS*	q ^{eq}	r*	TS ^{eq}
.5	2.67	-1.33	10854	3.37	-.37	10711
0.75	2.29	-1.14	11989	2.94	.06	11754
1	2	-1	13498	2.58	.42	13169
1.5	1.6	-0.8	17665	2.05	.95	17160
2	1.33	-0.67	23397	1.69	1.31	22740

Conclusions

- Results reported are based on a model
- Bertrand competition performs well in the model
- Content blocking unambiguously lowers total surplus
- Allowing platforms to charge user fees for content providers affects both total surplus and the distribution of surplus
 - Content usage fees close to zero maximize surplus in some cases
 - As content provision becomes more profitable, optimal usage charges increase

Thanks!
tēnā koutou
gracias



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