

Innovation through discrimination!?

The Net Neutrality debate

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Agenda

- **The Net Neutrality debate**
- Economic model
- Innovation, investment and policy results

Net Neutrality – Two definitions

„Net Neutrality means no discrimination. Net Neutrality prevents Internet providers from blocking, speeding up or slowing down Web content based on its source, ownership or destination.“

(<http://www.savetheinternet.com/=faq#what>)

Net Neutrality „...usually means that broadband service providers charge consumers only once for Internet access, do not favor one content provider over another, and do not charge content providers for sending information over broadband lines to end users.“

(Hahn et al. 2006)

Discrimination – Content vs. Transmission

Content discrimination

- Insulating its own affiliated content or service from competition by **blocking or degrading the quality of outside content or services**.
 - Mobile phone operators
 - VoIP
 - Call-through numbers

Transmission discrimination

- Offering service classes with different priority in the network independent of content or service characteristics. (QoS)
- P2P traffic
 - **Cost reduction**
- Refuse to distribute an affiliate content or service over competing conducts

The Net Neutrality Debate – Innovation

Neutrality

- **End-to-End principle** fosters “innovation” on the Internet
 - Dumb pipes: No network judge
- **Innovation at the edge**
 - No comparative disadvantage for start-ups
 - Critical mass
 - No constant revenue stream

Discrimination

- Best-effort transportation inappropriate for emerging **demanding services**
- Enables **higher reliability** of transportation
 - Healthcare
 - Security
 - etc.

The Net Neutrality Debate – Infrastructure

Neutrality

- Best-Effort transmission necessitates **overprovisioning** of network capacity to guarantee a certain transportation quality
- Content providers participate not directly on the infrastructure investments of the ISP

Discrimination

- Content providers' payments support ISP's infrastructure investments
- Danger of **artificial quality reduction** (reduced capacity expansion) to generate higher prioritization premiums?

The Net Neutrality Debate – Literature Overview

Disciplines

Law

Economics

Engineering

Involved Parties

Contra

- Network Service Provider
- Network Equipment Provider

Pro

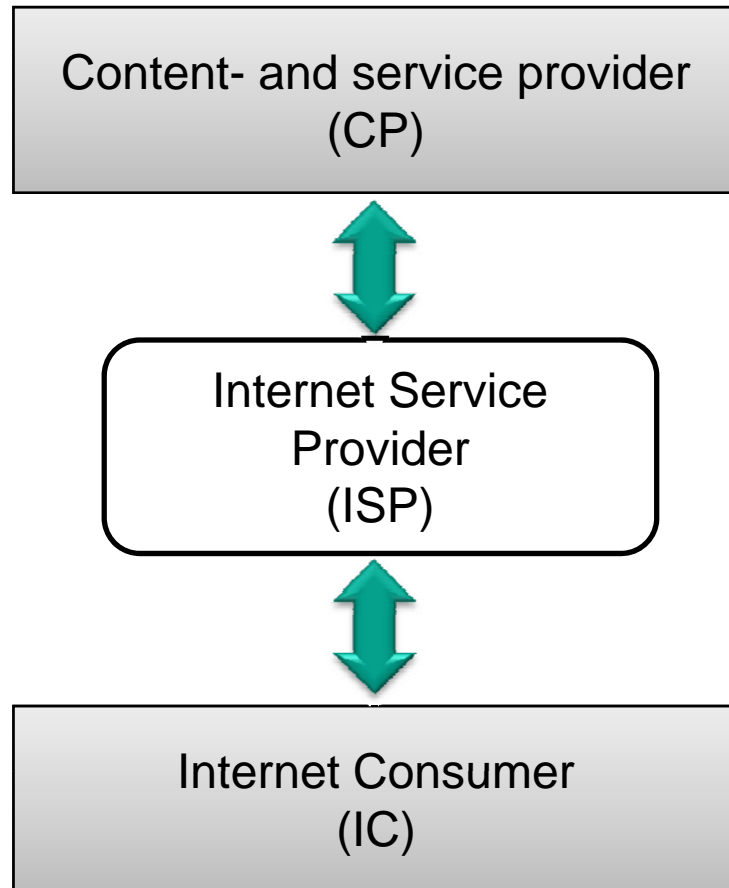
- Content and Service Provider
- Consumer Rights Groups

- Net Neutrality is at length discussed in the law domain with a very rich set of existing literature
 - Wu, T. (2003). Network neutrality, broadband discrimination. *Journal of Telecommunications and High Technology Law*.
 - Yoo, C. (2005). Beyond Network Neutrality. *Harvard Journal of Law & Technology*.
 - Yoo, C. (2006). Network Neutrality and the Economics of Congestion. *Georgetown Law Journal*.
- Very few analytical economic papers exist until now
 - Hermalin, B., & Katz, M. (2007). The economics of product-line restrictions with an application to the network neutrality debate. *Information Economics and Policy*.
 - Economides, N., & Tåg, J. (2007). Net Neutrality on the Internet: A Two-Sided Market Analysis. *Workingpaper*.
 - Cheng, H.K. et al. (2009). The Debate on Net Neutrality: A Policy Perspective. *Information Systems Research*. (forthc.)

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- **Economic model**
- Innovation, investment and policy results

Neutrality – The benchmark case



Revenue (r) through advertisements

Revenue generation is congestion-sensitive (θ)

$$U_{CP}^N(\theta_i) = (L - \theta_i w^N) r \alpha$$

Earn money from consumers' access fee (a)

$$\Pi^N = \alpha a^N$$

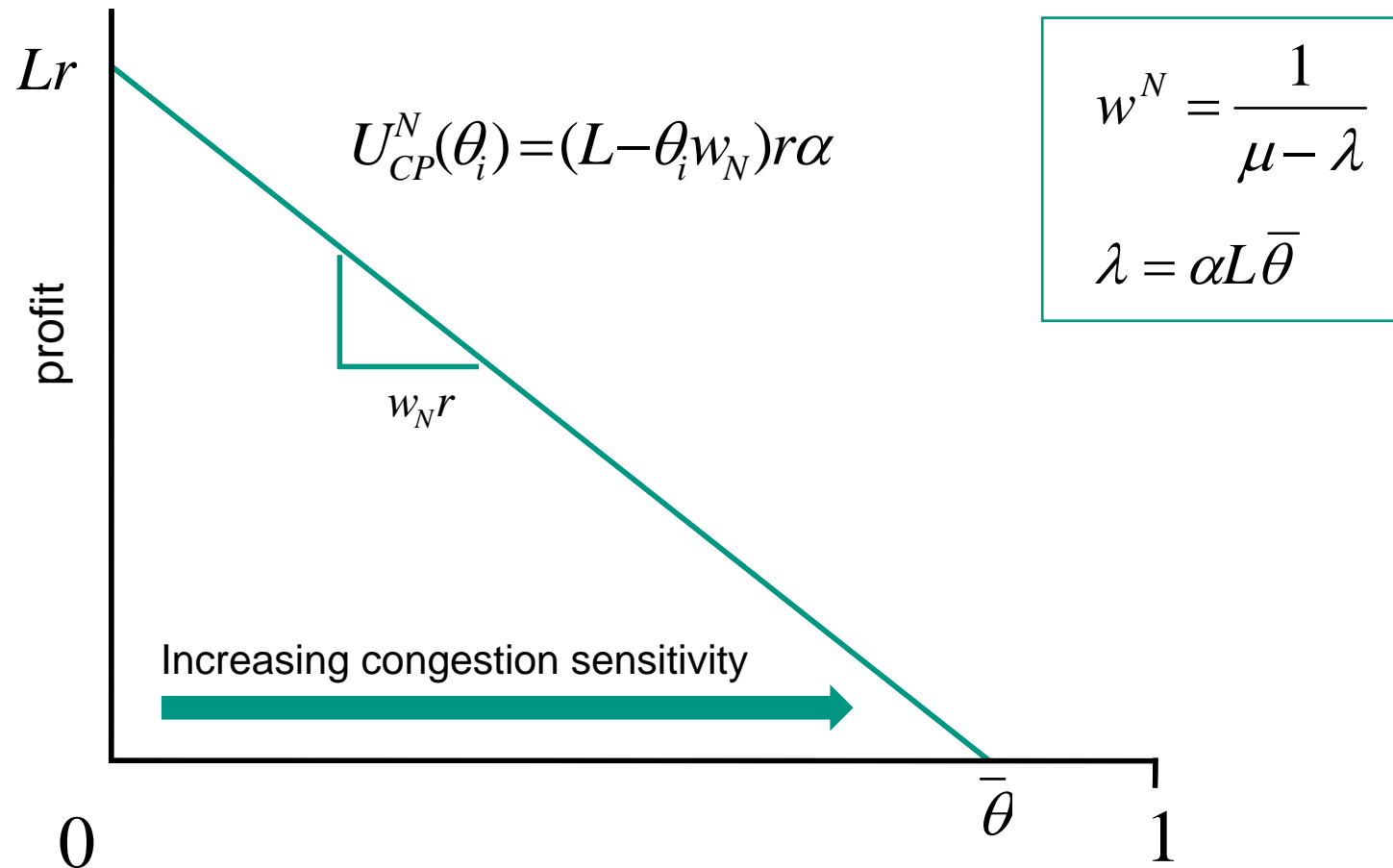
Value connectedness (h)

Value content variety ($v^* \theta$)

Dislike network congestion (c)

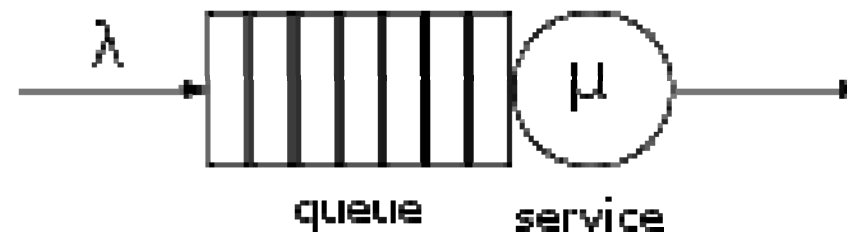
$$U_{IC}^N = h + v \theta^N - c \hat{w} - t \alpha - a^N$$

Content variety and congestion sensitivity



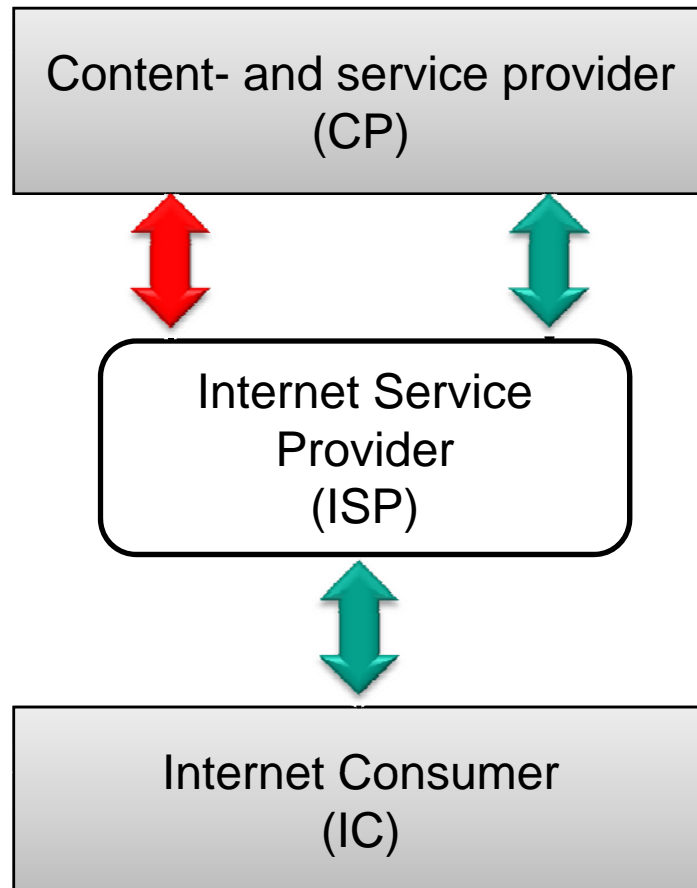
M/M/1 – A standard queueing model

- Traffic requests (λ) arriving at the network are queued
- The congestion level (w) depends on capacity (μ) of the network and the share (β) of content providers buying first priority access



$$w_2^D = w_1^D \frac{\mu}{\mu - \lambda} > w^N = \frac{1}{\mu - \lambda} > w_1^D = \frac{1}{\mu - \beta\lambda}$$

Discrimination



Generate revenue through clicks on advertisements (r)
 Revenue generation is congestion-sensitive (θ)

$$U_{CP}^D(\theta_i) = \begin{cases} (L - \theta_i w_2^D) r \alpha & \text{Best-effort} \\ (L - \theta_i w_1^D) r \alpha - p & \text{Priority} \end{cases}$$

Earn money from consumers' access fee (a)
 Earn money from content providers' priority fee (p)

$$\Pi^D = \alpha a^D + \beta \bar{\theta}^D p$$

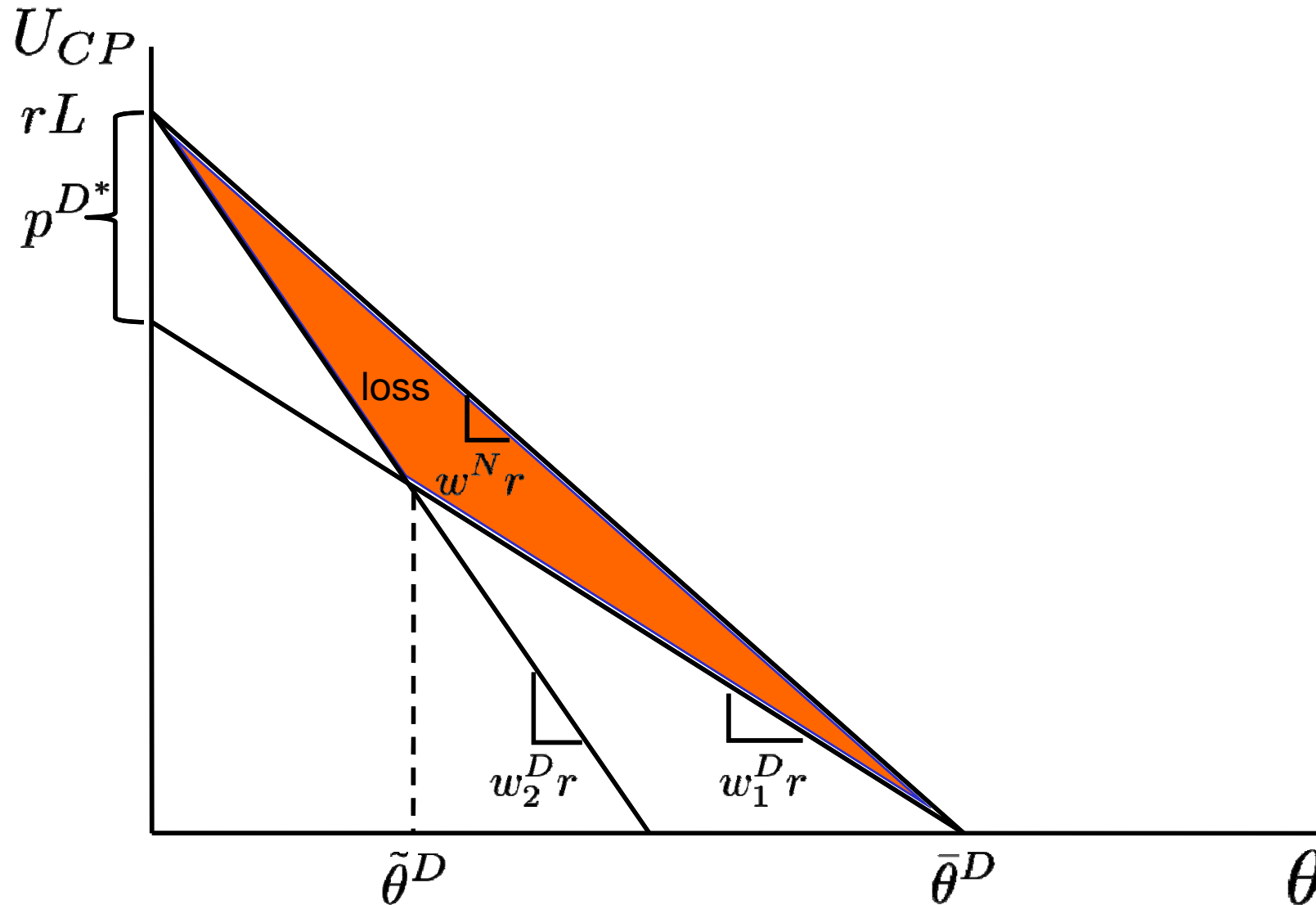
Value connectedness (h)
 Value content variety ($v^* \theta$)
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$$U_{IC}^D = h + v \bar{\theta}^D - c \hat{w} - t \alpha - a^D$$

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- The Net Neutrality debate
- Economic model
- **Innovation, investment and policy results**

Short-run effect on content providers' surplus



Short-run effects on innovation

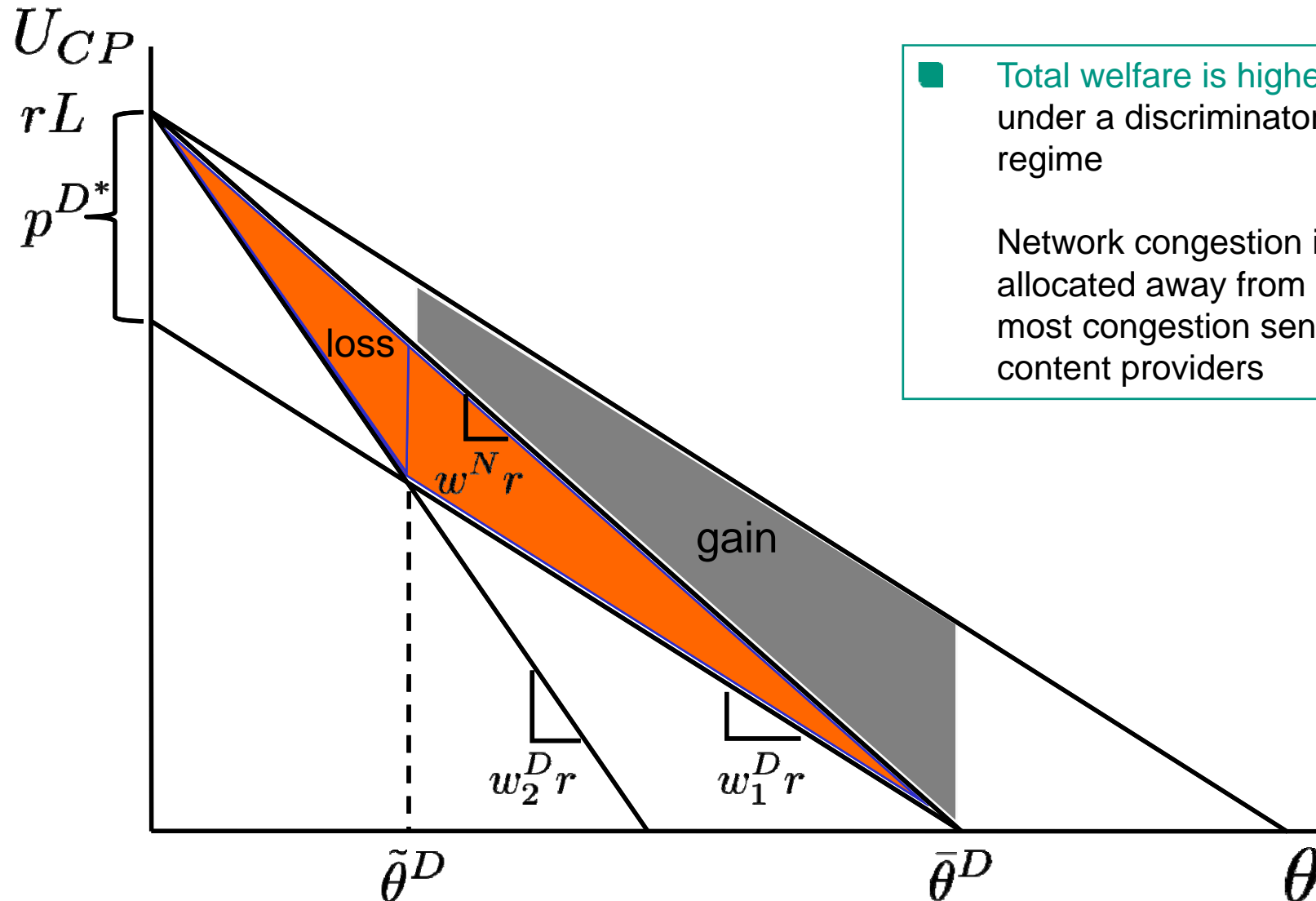
- In the short run all content providers earn less under a discriminatory regime.
- This surplus is expropriated by the ISP.
- But the introduction of a discriminatory network regime does not reduce the number of active content providers in the market.

Short-run effects on welfare

- Total welfare is higher under a discriminatory regime
 - Network congestion is allocated away from the most congestion sensitive content providers

$$\begin{aligned}
 \Delta W_s &= \Delta \Pi_s^D + \Delta U_{CP}^D \\
 &= \underbrace{\beta \bar{\theta} p^D}_{\text{priority charge}} + \underbrace{r(w^N - w_1^D) \int_{\theta=\tilde{\theta}}^{\bar{\theta}} \theta d\theta}_{\text{congestion alleviation to priority class}} \\
 &\quad - \underbrace{r(w_2^D - w^N) \int_{\theta=0}^{\tilde{\theta}} \theta d\theta}_{\text{congestion aggravation to best-effort class}} - \underbrace{\int_{\theta=\tilde{\theta}}^{\bar{\theta}} p^D d\theta}_{\text{priority charge}}
 \end{aligned}$$

Short-run effects on welfare



■ Total welfare is higher under a discriminatory regime

Network congestion is allocated away from the most congestion sensitive content providers

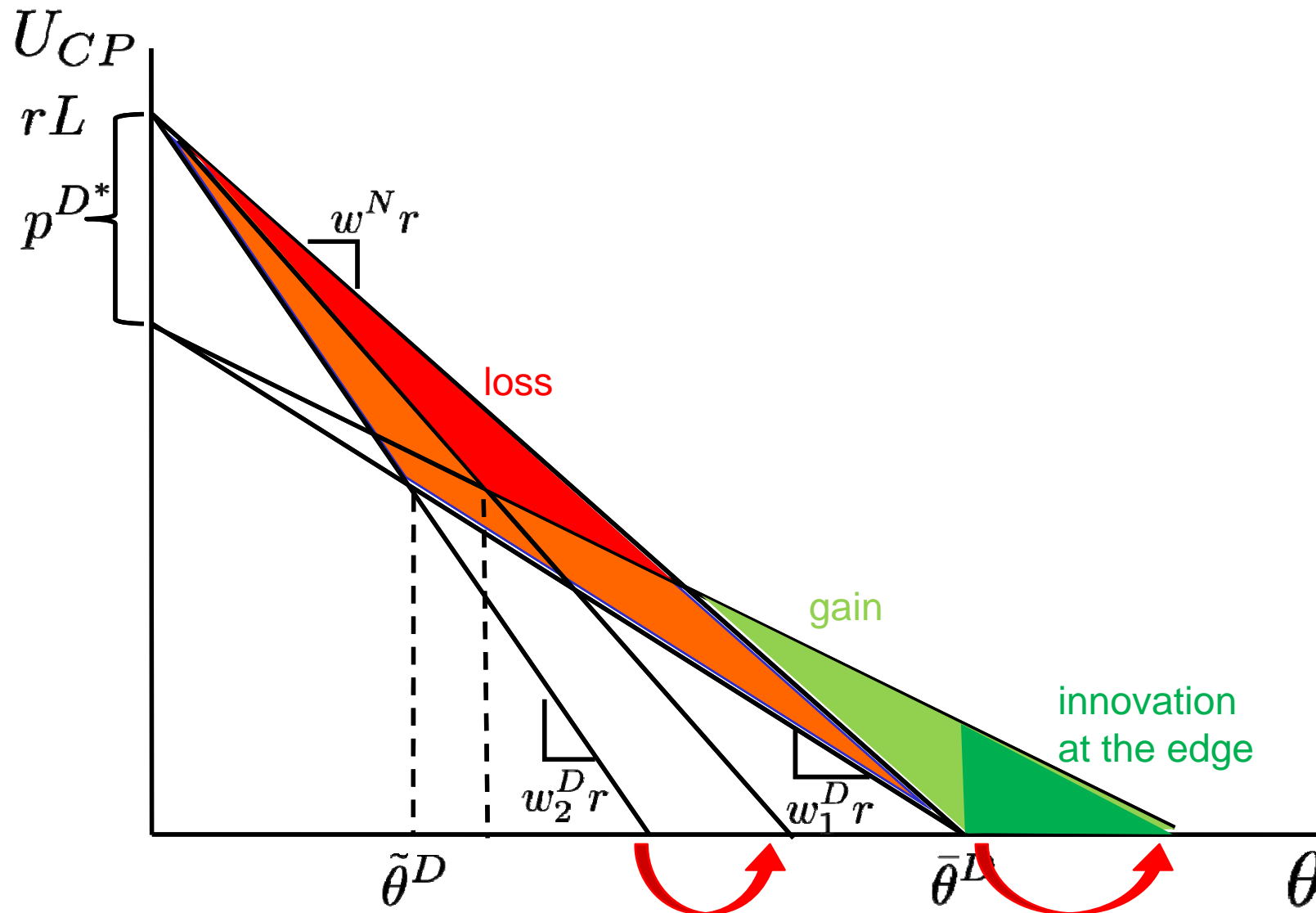
Long Run Effects

- In the long run capacity is not fixed and the incentives for infrastructure investments are different in both regimes

$$MR^D = \underbrace{\frac{vL}{(L^2 + 1)}}_{\text{variety incentive}} + \underbrace{\frac{c(L^2 + 1)}{\mu^2}}_{\text{congestion avoidance incentive}} + \underbrace{\left(1 - \frac{p^{D^*}}{(Lr - p^{D^*})L^2}\right) \frac{p^{D^*} L}{(L^2 + 1)}}_{\text{priority revenue incentive}}$$

- Under network discrimination the ISP has **stronger incentives to increase capacity**
- **The overall congestion level is lower under discrimination**
- More content providers enter the market which can be interpreted as **innovation at the edge**

Priority revenue effect



Outlook

- Power user
- P2P – Degradation
- Competition between ISP's
- Capacity regulation

Thank you for your attention...

BACKUP

- Assumptions
- Average vs. Accumulated waiting time
- Regulation

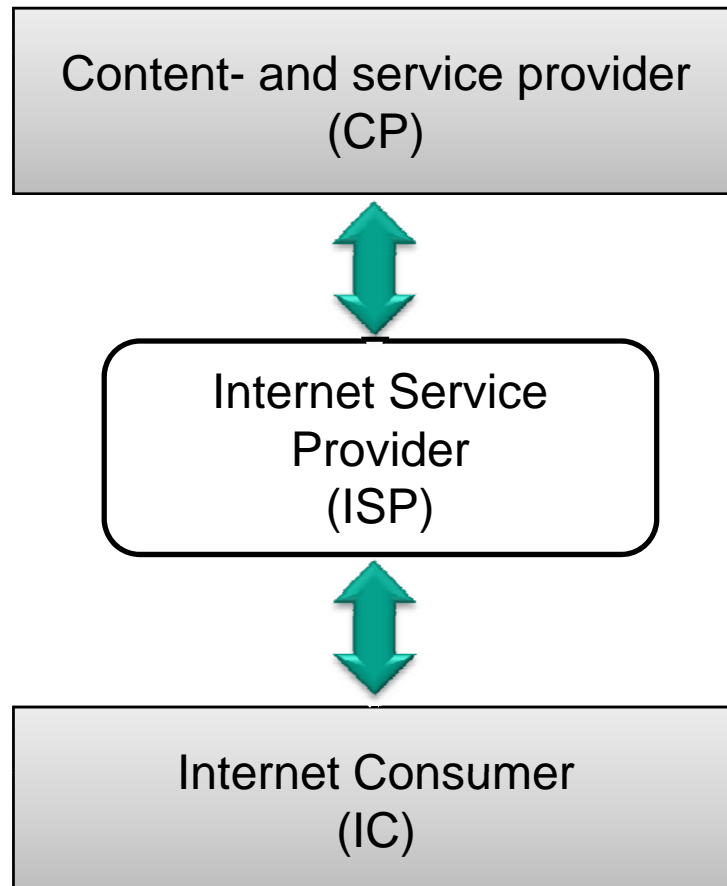
Basic Framework

- Users value the **connectedness** (h) to the network positively
- Users value the **number of content providers** (θ) which connect to the platform positively (v)
- Users suffer from waiting time through waiting costs
- Users pay an **access fee** (a) to the platform owner
- **Waiting time** (w) in a network depends negatively on the **capacity** (μ) the platform offers and positively on **the average total number of service requests** (λ) from the consumer side
- The business of content- and application providers is diverse sensitive to the average waiting time in the network

Assumptions

- In equilibrium all consumers buy access from the monopolistic platform
- Content- and application provider are not in competition to each other (independent monopolists)
- Each content provider gets the same average **number of service requests (L)** from the consumer side
- Content providers are uniformly distributed according to their sensitivity

Neutrality – The benchmark case (B)



Revenue (r) through advertisements

Revenue generation is congestion-sensitive (θ)

$$U_{CP}^N(\theta_i) = (r - \theta_i w^N) L \alpha$$

Earn money from consumers' access fee (a)

$$\Pi^N = \alpha a^N$$

Value connectedness (h)

Value content variety ($v^* \theta$)

Dislike network congestion (c)

$$U_{IC}^N = h + v \theta^{-N} - c \hat{w} - t \alpha - a^N$$

Average vs. Cumulated waiting time

Average waiting time:

$$\hat{w} = \beta w_1 + (1 - \beta) w_2$$

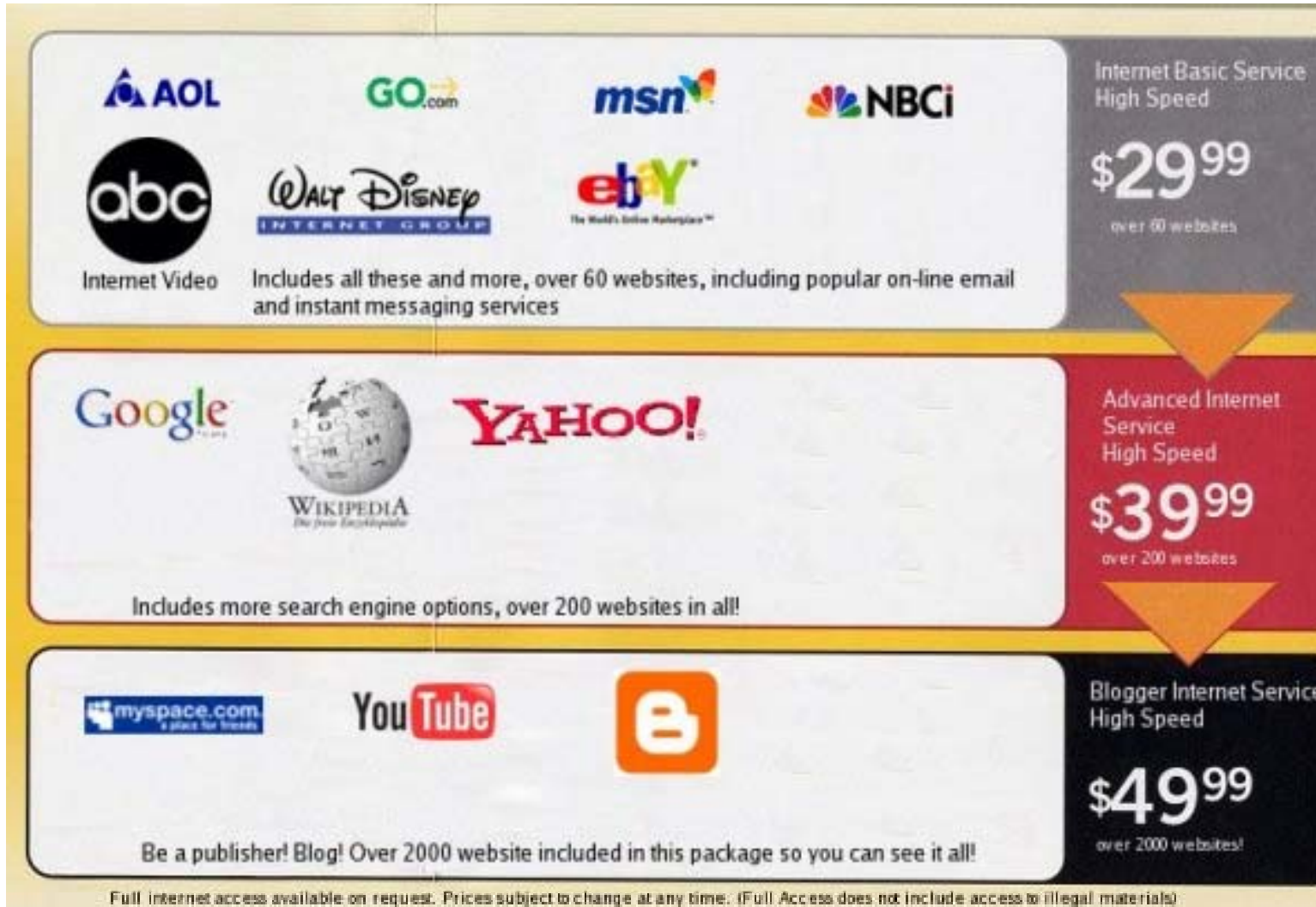
Cumulated waiting time:

$$\tilde{w} = \frac{\beta^2}{2} w_1 + \frac{(1 - \beta)^2}{2} w_2$$

$$p^{D*} = Lr \left(1 - \frac{1}{\sqrt{L^2 + 1}} \right)$$

$$U_{IC} = h + v\bar{\theta} - cw - t\alpha - a$$

A world without a neutral network?



Service Name	Price	Website Access
Internet Basic Service High Speed	\$29.99	over 60 websites
Advanced Internet Service High Speed	\$39.99	over 200 websites
Blogger Internet Service High Speed	\$49.99	over 2000 websites!

Full internet access available on request. Prices subject to change at any time. (Full Access does not include access to illegal materials)

Quelle: http://digg.com/odd_stuff/Why_net_neutrality_is_important_pic

Price Regulation

- The ISP and regulators incentives are perfectly aligned with respect to the priority and access fees
 - If p is too low, there will be excessive congestion in the priority class
 - If p is too high, there will be excessive congestion in the best-effort class
 - → Price regulation cannot improve welfare

Effect of price regulation on content providers' surplus

