

Network neutrality

The principle

- Network neutrality advocates no restrictions by ISPs on consumers' access to networks that participate in the internet
- Specifically, network neutrality would prevent restrictions on content, sites, platforms, the kinds of equipment that may be attached, or the modes of communication
- Since the early 2000s there are concerns about the ability of broadband providers to use their last mile infrastructure to block Internet applications and content (e.g., websites, services, protocols), even blocking out competitors
- In the US particularly, but elsewhere as well, the possibility of regulations designed to mandate the neutrality of the Internet has been subject to fierce debate.

The big debate: Net neutrality

- We don't want to create a world like television where in order to get your voice heard, you really need to have the backing of a major corporate network
- When companies have both strong business incentives and the technical ability to interfere with Web content, it doesn't take a crystal ball to predict that they will do so
- the government must ensure that [broadband] operators do not encumber relationships between their customers and destinations on the network
- Competitive broadband distribution would allow us to rely upon market forces, rather than government regulation, to govern market structure and service provision

Google

Network neutrality is the principle that Internet users should be in control of what content they view and what applications they use on the Internet. The Internet has operated according to this neutrality principle since its earliest days...

Fundamentally, net neutrality is about equal access to the Internet. In our view, the broadband carriers should not be permitted to use their market power to discriminate against competing applications or content. Just as telephone companies are not permitted to tell consumers who they can call or what they can say, broadband carriers should not be allowed to use their market power to control activity online.

—*Guide to Net Neutrality for Google Users*

Why network neutrality

1. Network Neutrality protections have existed for the entire history of the Internet.
2. Network discrimination through a “tiered Internet” creates artificial scarcity, and will severely curtail consumer choice, giving consumer control over the Internet to the network owners.
3. Network discrimination through a “tiered Internet” will undermine innovation, investment, and competition.
4. Network discrimination through a “tiered Internet” will fundamentally alter the consumer’s online experience by creating fast and slow lanes for Internet content. Network prioritization is a zero-sum game.
5. No one has a “free ride” on the Internet. Network operators have the revenue streams to support infrastructure development.
6. Telephone companies have received billions of dollars in public subsidies over the years to support network build-out.
7. There is little competition in the broadband market, certainly not enough to punish anti-competitive behavior.
8. Consumers will bear the costs for network infrastructure regardless of whether there is Network Neutrality or not.
9. Investing in increased bandwidth is the most efficient way to solve network congestion problems; discrimination creates an incentive to maintain scarcity.
10. Network owners have explicitly stated their intent to scrap Network Neutrality guarantees and build business models based on network discrimination.

Why NOT network neutrality

- Opponents of net neutrality include hardware companies and members of the cable and telecommunications industries, including major telecommunications providers.
- A number of these opponents have created a website “Hands Off The Internet”. Principal financial support for the website comes from AT&T, and members include technology firms
- **Net neutrality is a slogan that would freeze innovation in the core of the Internet**

Why NOT network neutrality (1)

- Prioritization of bandwidth is necessary for future innovation on the Internet and Telecom providers should have the ability to provide preferential treatment in the form of tiered services
 - give online companies willing to pay the ability to transfer their data packets faster than other Internet traffic
- The added revenue from such services could be used to pay for the building of increased broadband access to more consumers. Net neutrality regulation would have adverse consequences for innovation and competition in the market for broadband access by making it more difficult to recoup their investments in broadband networks
- ISPs have accused Google and Skype of free riding for using a network of lines and cables the phone company spent billions of dollars to build. **Eyeball ISPs should charge content providers for accessing their customers**
 - Economics of congestion: A neutral network is like a public good, leading to collective action or tragedy of the commons-like problems
 - YouTube streams as much data in three months as the world's radio, cable and broadcast television channels stream in one year, 75 petabytes. Today's networks are not remotely prepared to handle the "exaflood". Net neutrality would prevent broadband networks from being built, which would limit available bandwidth and thus endanger innovation

Why NOT network neutrality (2)

- Large companies already achieve a performance advantage over smaller competitors by replicating servers and buying high-bandwidth services or using CDNs
- Should prices drop for lower levels of access, or access to only certain protocols, this would make Internet usage more neutral, with respect to the needs of those individuals and corporations specifically seeking differentiated tiers of service
- The current Internet is not neutral as among all applications its implementation of best effort generally favors file transfer and other non-time sensitive traffic over real-time communications
- Opposition to legislation: given a rapidly-changing technological and market environment, many in the public policy area question the government's ability to make and maintain meaningful regulation that doesn't cause more harm than good by making difficult to ISPs to perform useful network management operations using packet filtering
- **Competition should solve all problems**, not legislation

Types of network neutrality

- Absolute non-discrimination: treat all content, sites, and platforms equally
- Limited discrimination without QoS tiering: allows quality of service discrimination as long as no special fee is charged for higher-quality service
- Limited discrimination and QoS tiering: allows higher fees for QoS as long as there is no exclusivity in service contracts
- No regulation: in this regime, any discrimination is allowed, including identity- based discrimination and exclusivity

FCC rules for net neutrality (Dec 2010)

- Transparency: Fixed and mobile broadband providers must disclose the network management practices, performance characteristics, and terms and conditions of their broadband services
- No blocking: Fixed broadband providers may not block lawful content, applications, services, or non-harmful devices; mobile broadband providers may not block lawful websites, or block applications that compete with their voice or video telephony services
- No unreasonable discrimination: Fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic
 - *“We understand the term “nondiscriminatory” to mean that a broadband Internet access service provider may not charge a content, application, or service provider for enhanced or prioritized access to the subscribers of the broadband Internet access service provider” (Oct 2009)*
- Exempted wireless networks from the last rule

The debate: against neutrality (C. Yoo)

- Instead of network neutrality a network diversity approach (pursue different routing approaches)
- New internet: heterogeneous demand by end-users, needs different treatment by network
 - This already happens: Akamai,...
- Using different protocols: more competition among platforms, multiple networks survive by targeting market segment
 - Makes possible three different last mile networks to coexist
- Better let practice demonstrate actual harm to consumers
- Today main focus on access tiering: charge more for premium services
 - Why not? Like FedEx! Why not improve TCP?
 - Each case is different, allow networks to experiment
 - Content exclusivity may be a differentiating strategy (Yahoo!+AT&T,...)
 - Problems may only involve directly competing applications

Against neutrality (C. Yoo)

- Vertical integration influences network neutrality, but may be a good thing if enough competition exist in the various markets
 - Regulation should focus on the least competitive segment
 - Current debate focuses on the wrong policy problem: applications and content are the most competitive segment of the industry
 - Should focus on last mile competition and market entry
 - Then tiering and blocking applications is not a problem any more
 - Network neutrality regulation reduces incentives for investment in last mile technologies, deprives would-be builders of alternative network capacity of their natural strategic partners
 - New wireless technologies and increased demand makes last mile markets contestable
 - Government cannot run access networks
 - Let the Googles and the AT&Ts fight...

The debate: for neutrality (T. Wu)

- Network neutrality is about discrimination
 - Some type of discrimination is useful, but not all
 - Successful applications should be chosen by the market
- Blocking applications is bad and networks have an incentive to do it
 - Network companies lose customer value by blocking
 - May gain more profit overall by blocking competing services
- Innovation and economic growth is driven by market entry
 - Vital to control barriers to market entry
 - Entry occurs in applications mostly
 - Not by incumbents (AT&T...)
- Access tiering discourages entry
 - AT&T- Yahoo!: like GE making a deal with the electricity company
 - Distortion of competition (best product does not win)
 - Offers incentive to maximize “gatekeeper revenues” by maintaining scarcity

For neutrality (T. Wu)

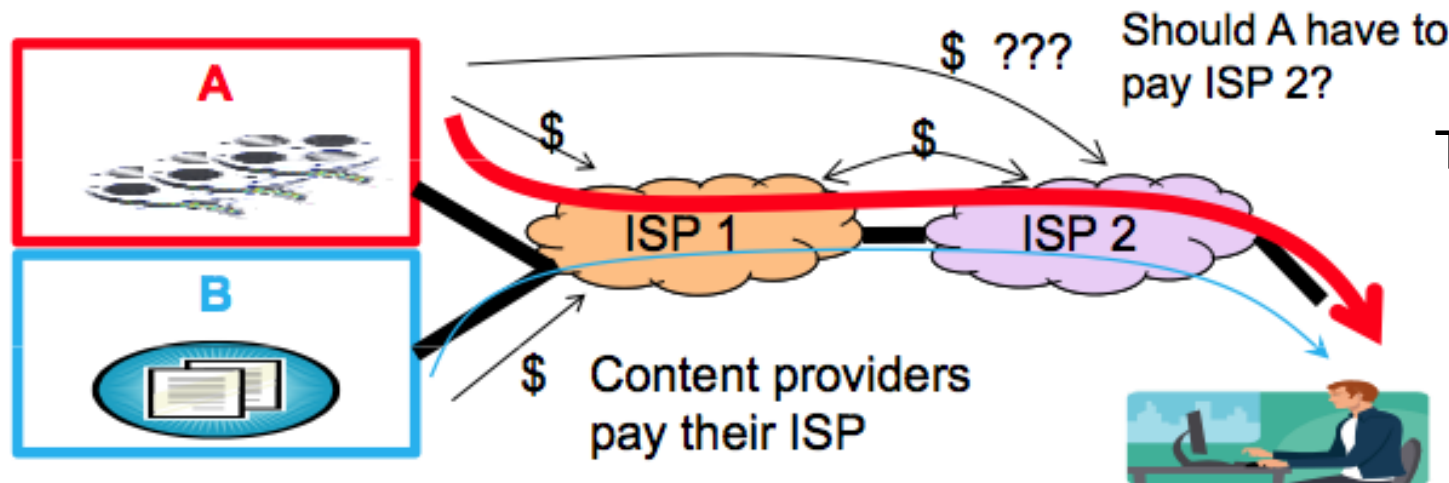
- Prohibition of network neutrality may hurt the lowest-end market entrants: the application companies
- Argument that access tiering promotes competition and innovation in the last mile is questionable, produces more harm than good
 - High fixed costs (but possible resale of spectrum)
 - History shows that last mile needs different policy to gain investments, or do nothing

Economics

- Use simple models that can provide insightful answers
 - two-sided market, investment and pricing decisions
- “Zero price rule”: should ISPs charge content providers for terminating their traffic?
- “Non-discrimination” rule: should ISPs be allowed to discriminate traffic by offering priorities and charging accordingly?
- Questions: is the SW increased? the consumer surplus? the content provider surplus? the ISP surplus?

The zero-price rule

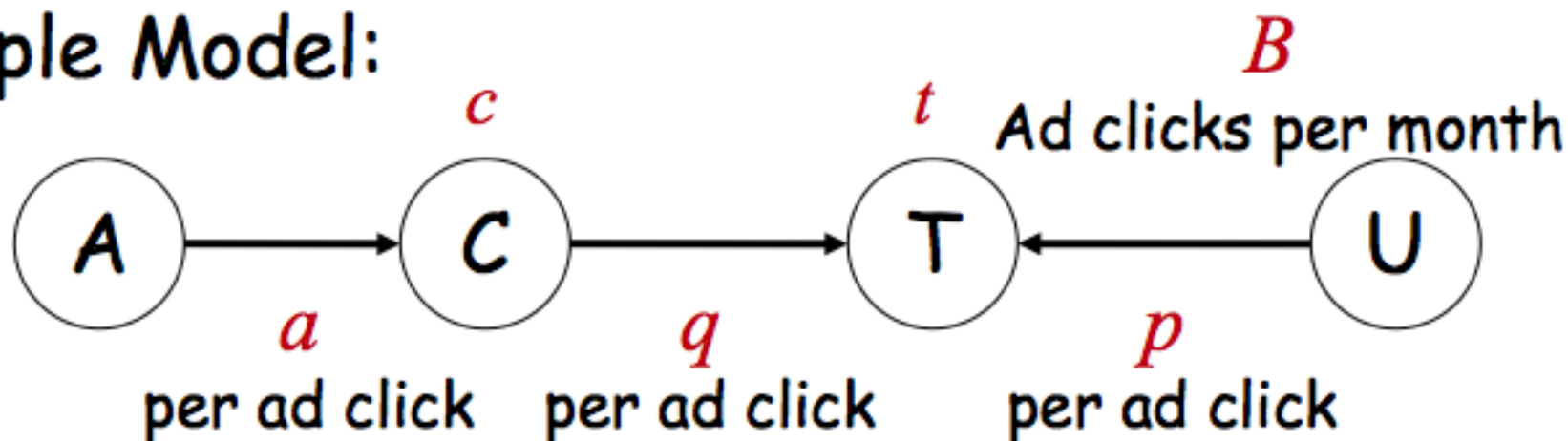
Sigmetrics 2008 – Tutorial: Economic Models of Communication Networks – Jean Walrand



Thanks Jean!

- Would allowing 2 to charge A
 - encourage 2 to invest?
 - discourage A to invest?
- What revenue sharing mechanisms should new Internet have?

Simple Model:



$$B = c^v t^w e^{-p/\theta} \quad 0 < v, w; v + w < 1$$

$$R_C = (a - q)B - \alpha c$$

$$R_T = (q + p)B - \beta t$$

Question:

$q \uparrow \Rightarrow R_T \uparrow$
or
 $q \uparrow \Rightarrow R_C \downarrow \Rightarrow c \downarrow \Rightarrow B \downarrow \Rightarrow R_T \downarrow$

A = advertisers
C = content provider
T = transport provider
U = regular users

Simple Model:

$$B = c^v t^w e^{-p/\theta} \quad 0 < v, w; v + w < 1$$

$$R_C = (a - q)B - \alpha c$$

$$R_T = (q + p)B - \beta t$$

Assume T chooses (t, p, q) . Then C chooses c to max

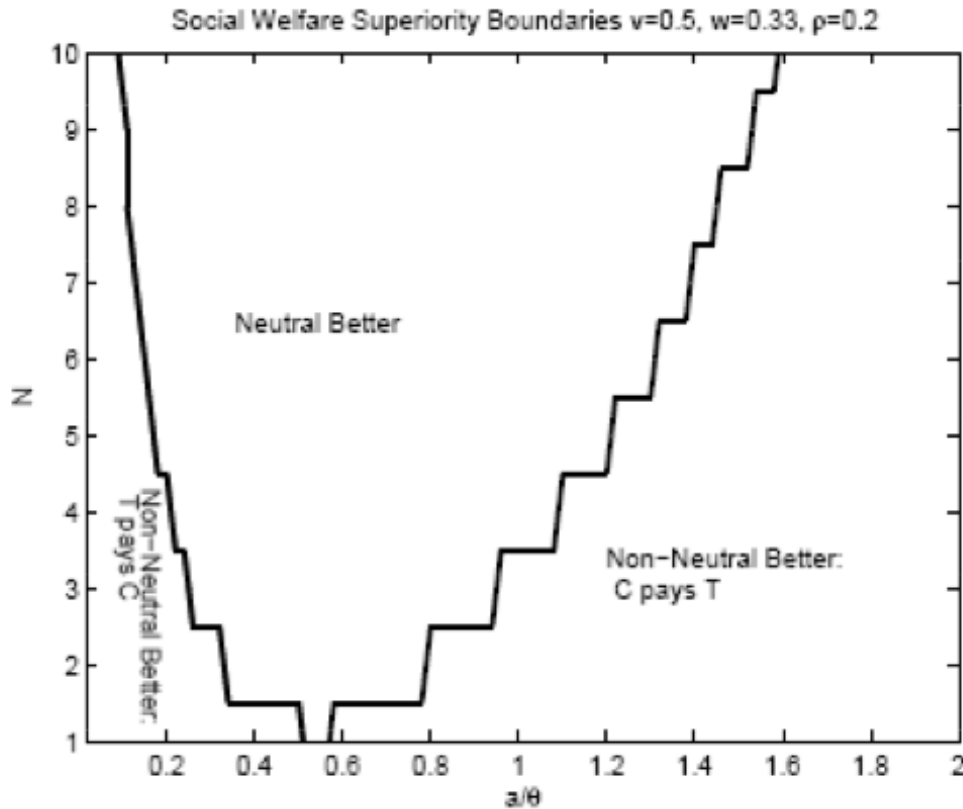
$$R_C = (a - q)c^c t^w e^{-p/\theta} - \alpha c$$

Given this $c(t, p, q)$, T then chooses (t, p, q) to max

$$R_B = (p + q)c^c t^w e^{-p/\theta} - \beta t$$

Results

- Authorizing termination fees is desirable when advertisement revenue is high (large a) or ISP demand is elastic (low θ)



Result 1:

The revenues per click and ROIs are the same under both regimes for content and transport providers.

Result 2:

The size of the market is larger in the neutral case only if a/θ is neither very large nor very small.

Non-discrimination (Hermalin and Katz (2007))

- Monopolist ISP charges content providers with different content (attractiveness) a fee for connecting with its consumers
- The fee depends on the quality of the connection chosen by the content provider (versioning, not personalized pricing)
- High types (those with highly attractive content) have a higher marginal valuation for connection quality
- In equilibrium, higher types purchase higher qualities. But only the highest type obtains the efficient quality, while all other types obtain a quality that is distorted downwards
- Restricting the ISP to offering a single connection quality has three effects on welfare: 1) reduces the set of content providers that are active (low types), 2) it reduces the efficiency of connection of high types who are forced to purchase the single, lower quality, 3) there are some intermediate types who purchase a more efficient quality
- The overall effect of the restriction is ambiguous, but often negative

More research

- Many conflicting factors
 - differentiation offers more choices, but extracts more surplus from content providers
 - if capacity increases, value of “fast lane” decreases
 - fast lane may pay for best effort, but the incentive might be to keep the best effort more congested
 - not clear what is the effect on price restrictions to consumers (currently they are used at a fixed low fee)

Some more thoughts (A. Odlyzko)

- If Google defeats AT&T in the battle over net neutrality, then (and likely in any case) society might have to get ready to regulate Google!
- Net neutrality controversy arises from a conflict between society's drives for economic efficiency and for fairness.
- Price differentiation exists

service	revenue per MB
wireless texting	\$1000.00
wireless voice	1.00
wireline voice	0.10
residential Internet	0.01
backbone Internet	0.0001

an estimated 70-80% of worldwide telecom revenues come from voice

- In particular the claims that net neutrality “is about streaming movies” is mistaken. If anything, net neutrality and the future of telecom in general, is far more about voice and the services that will succeed voice in importance. The key issue is how to extract payment from customers when voice, the most valuable service they receive, is a free feature of the basic broadband connectivity they buy.

Some more thoughts (cont)

- Content is not King! and the myth of “streaming movies”
 - no “exafloods” are swamping the Internet
 - movies should not be delivered in real-time streaming mode
- Price discrimination has traditionally been disliked and feared, and has usually been strictly limited
 - existed before, already exists (Google pays $\times 100$ < than users per byte).
Google’s business: behavioral targeting in all Internet transactions
- CAPEX for networks is low, there is plenty of profit
 - The existing US network of 340b\$ can be duplicated for 180b\$!
 - true costs are lower than depreciation
- Flat rate is fine
 - example from dialup pricing
 - segmentation by speed of connection
- Established service providers are terrible at innovation
 - better promote development of applications (social interactivity)

Threat of discrimination

Based on B. van Schevick, "Towards an Economic Framework for Network Neutrality Regulation", Journal of Telecommunications and High Technology Law.

- Network providers (network service) have incentives to discriminate against unaffiliated providers of complementary products (applications, portals)?
- Simple model:
 - Network service market = monopoly
 - Services market = competitive
- Theorem: A monopolist has no incentive to interfere in a complementary product market if the complementary product is used in fixed proportions with the monopoly good and is competitively supplied
- He may benefit from competition in the complementary market (**ICE: internalizing complementary efficiencies**)
- Exceptions for the Internet?

Exceptions

- Complementary product source of outside revenue
 - Portals have outside revenue from advertisement
 - Charge portals a fee on this revenue, or exclude them
- Complementary product is competing with outside services sold by the monopolist
 - Monopolist offers PSTN voice service
 - Complementary product = VoIP
- Monopolist may offer complementary product in a systems market (that he controls) and a stand-alone market (he does not control)
 - Network provider offers portal services nationwide
 - System market: network customers, stand-alone=rest

Exceptions (cont.)

- Monopoly preservation in the primary market
 - Monopolist faces potential competition
 - Deters entry by exclusionary conduct in the complementary market
 - An entrant needs to enter both markets simultaneously
- Profitability of discrimination without monopolization
 - Just increase sales in complementary market is enough
 - Exclude competitors
- Duopoly model in primary market also motivates exclusion in complementary market
 - Ability to exclude does not need monopoly power as a precondition

Cost of exclusion

- Lower price since value of service is lower
- Customers may switch providers
- Smart policy: use discrimination instead of direct exclusion
 - Change customer perception of quality of rival offering
 - Lower cost!

Incentives for innovation

- Application-level innovation
 - Threat of discrimination reduces incentive for innovation, since profits will be lower
 - Uncertainty due to “test the waters” policy of the network operator
- Network-level innovation
 - Regulation implies lower profits hence less incentive
- Trade-offs of net neutrality regulation
 - Innovation in network technology: more global effects
=>Balance of incentives even if regulated
 - Appl. level innovation vs deployment of net infrastructure
 - No problem since network ops may participate in application markets, just do not block others

Conclusion

- First instance of Internet regulation
- Tricky to define in precise terms
- Network operators should not have the opportunity to strategically discriminate against independent producers of applications, contents or portals
- Such discrimination will reduce the amount of innovation in this complementary market and reduce social welfare
- But offering more quality of service choices seems to be positive in general if customers make the choice instead of the ISP