

Network Neutrality

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What is Network Neutrality? (Wu)

- **Ideal: “shorthand for a system of belief about innovation policy”**
- **Implementation: Regulate behavior rather than structure**
 - Precedent: Computer Inquiries
 - Earlier: line of business restrictions; Later: ONA/CEI
- **Objectionable behavior = “unjustified” discrimination**
 - Assumes a way to distinguish “legitimate” from “unjustified” (i.e. harmful) discrimination
- **Wu’s proposal**
 - Implicitly based on layers model
 - OK to discriminate within a network (Layer 3 and below)
 - Not OK to discriminate across networks (above internetwork layer)
- **Critiques?**

Network Discrimination

- **Technical & contractual means**
 - Legitimate vs. discriminatory ends
- **Economic incentives**
 - Theory vs. reality, monopolist vs. not
- **Policy responses**
 - Academics, FCC, Congress

Technical Means

- **IP address assignment**
 - Static vs. dynamic
- **Filtering based on application-level names/addresses (e.g. URLs)**
 - Workplace policies (e.g. Allot's "NetPure" product)
 - State censorship
 - Indicator of "preferred" sites? (Felten)
- **Filtering based on entire application**
 - Simplistic: filter well-known port numbers (P2P, VPN, 3rd-party VoIP or SMTP)
- **Filtering based on combination of factors: "deep packet inspection"**
 - Subscriber identity, device, location
 - Other end of packet exchange
 - Content itself
 - Protocols through Layer 7 (application and other)
 - Direction of data transfer

Cisco: Deep Packet Inspection

Figure removed for copyright reasons.

Figure 1 in "DEPLOYING PREMIUM SERVICES USING CISCO SERVICE CONTROL TECHNOLOGY." Cisco Systems.

http://www.cisco.com/en/US/products/ps6150/prod_brochure0900aecd8025258e.html
(Accessed 16 August 2006.)

Technical Means, cont.

- **Traffic “profiling”**

- Patterns of traffic flow, not just packet internals
- Useful for detecting and blocking malware “in the network”
- Also a way to “manage” encrypted traffic?

- **Traffic shaping / bandwidth management**

- QoS (minimum performance needs, vary by application)
 - Which packets to transmit first or drop when contention?
 - Enable higher loadings for given network capacity
 - QoS options visible externally, or purely internal? (similar issue w/multicast)
- “Fairness”
 - TCP friendliness
 - “Bandwidth hogs”
 - Felten: “minimal” vs. “non-minimal” packet discrimination
- Enforcement of pricing policies
 - Peak-rate tiers, volume caps, time-of-day pricing, congestion pricing, etc.

- **Caching**

- Not all content created equal

Contractual Means (Wu's survey, 2002)

- **Home networking / Wi-Fi**
- **Reselling service / acting as ISP**
- **Commercial or business use**
- **Operating a server**
- **Hacking, security breaches, spam, consumer fraud**
- **Any unlawful purpose**
- **Any offensive or immoral purpose**

Economic Incentives for Network Operators: Farrell & Weiser Paper

- **Model**
 - Platforms vs. Complements (upstream or downstream)
 - Platform (i.e. network operator) is monopolist
- **Theory: Internalizing Complementary Efficiencies (ICE)**
 - Economic theory
 - Law of “one monopoly profit” or no double marginalization (Cournot, 1838)
 - Economides & Lehr explain: “An integrated monopolist producing both A and B will charge less than two vertically-related monopolists, each producing one component only.”
 - Intuition
 - If there are positive externalities from encouraging complements, monopolist will do so and internalize the benefits
 - Complements create more consumer value, make platform worth more
 - Monopolist appropriates these benefits by charging more for the platform
 - So, monopolist doesn’t have incentive to discourage complementary innovations, even if vertically integrated
 - With some notable exceptions...

Farrell & Weiser's Exceptions ("Holes in the ICE"), part 1

- **Baxter's Law**
 - Regulated monopolist, can't recover added value in platform prices
 - Consider: Western Electric equipment prices pre-divestiture
- **Price Discrimination**
 - "Platform monopolist may impose highly inefficient restrictions on applications competition in order to engage in price discrimination" [in the applications market]
 - "For example, in the Internet environment, customer identity might be more readily tracked through the complement than through the platform product"
- **Potential Competition**
 - Complements evolve to threaten the platform, via substitution or entry
 - Consider: cable's restrictions on streaming video; VoIP revenue cannibalization for telcos
- **Bargaining Problems**
 - Monopolist may not be credible partner if also in complementary markets
 - Consider: cases of voluntary structural separation (Palm; Intel)

Farrell & Weiser's Exceptions, part 2

- **Incompetent Incumbents**

- Firms may fail to appreciate (counter-intuitive) ICE, value of modularity
- Especially when emerging from fully integrated regulated system

- **Option Value**

- Once firm pursues open/modular strategy, regulators may not let it change course even if full integration later proves more efficient

- **Regulatory Strategy Considerations**

- Openness in one domain may force openness in others (consider cable TV)

- **Incomplete Complementarity**

- If applications (complements) have value without the platform (or on other platforms), then platform provider can gain by monopolizing complements
- Intuition: can't capture full value from these applications via the platform

Discussion: Economics of Discrimination

- **Other exceptions to ICE?**
- **Appropriability issue**
 - Farrell & Weiser, Footnote 74: Suggests that monopolist may not always be able to appropriate (internalize) all the value that unfettered complementors might create
- **van Schewick's analysis**
 - Can broadband access provider charge consumers more based on:
 - Value of personal information collected by independent application/service providers?
 - Value of Google's advertising?
 - What if the platform is not a monopoly?
 - Maximizing overall consumer value (size of the pie) may now conflict with maximizing size of individual firm's portion
 - OTOH, does it become harder to get away with discrimination?
 - Other considerations from information economics, firm strategy
- **Issues with applying the ICE model**
 - Policy value of economic model burdened with complex set of qualifications and exceptions?
 - Is the network operator the only relevant "platform"?
 - Ultimately, is discrimination the concern, or market power?

Policy Responses (FCC): Michael Powell's "Four Freedoms"

- **Freedom to Access Content.** First, consumers should have access to their choice of legal content.
 - ... I challenge all facets of the industry to commit to allowing consumers to reach the content of their choice. **I recognize that network operators have a legitimate need to manage their networks and ensure a quality experience, thus reasonable limits sometimes must be placed in service contracts. Such restraints, however, should be clearly spelled out and should be as minimal as necessary.**
- **Freedom to Use Applications.** Second, consumers should be able to run applications of their choice.
 - ... No one can know for sure which “killer” applications will emerge to drive deployment of the next generation high-speed technologies. Thus, I challenge all facets of the industry to let the market work and allow consumers to run applications **unless they exceed service plan limitations or harm the provider’s network.**
- **Freedom to Attach Personal Devices.** Third, consumers should be permitted to attach any devices they choose to the connection in their homes.
 - ...I challenge all facets of the industry to permit consumers to attach any devices they choose to their broadband connection, **so long as the devices operate within service plan limitations and do not harm the provider’s network or enable theft of service.**
- **Freedom to Obtain Service Plan Information.** Fourth, consumers should receive meaningful information regarding their service plans.
 - ...Providers have every right to offer a variety of service tiers with varying bandwidth and feature options. Consumers need to know about these choices as well as whether and how their service plans protect them against spam, spyware and other potential invasions of privacy. Thus, I challenge all facets of the industry to ensure that broadband consumers can easily obtain the information they need to make rational choices among an ever-expanding array of different pricing and service plans.

From Powell Speech, “PRESERVING INTERNET FREEDOM: GUIDING PRINCIPLES FOR THE INDUSTRY” presented at Silicon Flatirons Digital Broadband Migration Conference, February 8, 2004.

Kevin Martin's FCC (August 5, 2005)

The Federal Communications Commission today adopted a **policy statement** that outlines four principles to encourage broadband deployment and preserve and promote the open and interconnected nature of public Internet:

1. Consumers are entitled to access the lawful Internet content of their choice;
2. Consumers are entitled to run applications **and services** of their choice, **subject to the needs of law enforcement**;
3. Consumers are entitled to connect their choice of **legal** devices that **do not harm the network**; and
4. Consumers are **entitled to competition among network providers, application and service providers, and content providers.**

Although the Commission did not adopt rules in this regard, it will incorporate these principles into its ongoing policymaking activities. **All of these principles are subject to reasonable network management.**

Cisco's Version of the Four Freedoms

- Broadband Internet access consumers should have access to their choice of legal Internet content **within the bandwidth limits and quality of service of their service plan.**
- Broadband Internet access consumers should be able to run applications of their choice, **within the bandwidth limits and quality of service of their service plans, as long as they do not harm the provider's network.**
- Consumers should be permitted to attach any devices they choose to their broadband Internet access connection **at the consumer's premises, so long as they operate within the bandwidth limits and quality of service of their service plans and do not harm the provider's network or enable theft of services.**
- Consumers should receive meaningful information regarding their broadband Internet access service plans.
- And in addition, Cisco supports “Network Management” principles:
 - Broadband Internet access service providers should remain free to engage in pro-competitive network management techniques to alleviate congestion, ameliorate capacity constraints, and enable new services.
 - Broadband Internet access service providers should remain free to offer additional services to supplement broadband Internet access, including bandwidth tiers, quality of service, security, anti-virus and anti-spam services, network management services, as well as to enter into commercially negotiated agreements with unaffiliated parties for the provision of such additional services.

Other Industry Responses

- **Ed Whitacre, SBC, fall 2005 (Business Week Interview)**

- Q: How concerned are you about Internet upstarts like Google, MSN, Vonage, and others?
- A: How do you think they're going to get to customers? Through a broadband pipe. Cable companies have them. We have them. Now what they would like to do is use my pipes free, but I ain't going to let them do that because we have spent this capital and we have to have a return on it. So there's going to have to be some mechanism for these people who use these pipes to pay for the portion they're using. Why should they be allowed to use my pipes?
- **The Internet can't be free in that sense, because we and the cable companies have made an investment and for a Google or Yahoo or Vonage or anybody to expect to use these pipes [for] free is nuts!**

- **Google (Cerf testimony), February 7, 2006**

- “A number of justifications have been created to support carrier control over consumer choices online; none stand up to scrutiny. Open-ended carrier discrimination is not needed to protect users from viruses, stop spam, preserve network integrity, make VOIP or video service work properly – or even insure that carriers are compensated for their broadband investments. In particular, **we firmly believe that carriers will be able to set market prices for Internet access and be well-paid for their investments** – as broadband carriers in other countries have successfully done.”
- “The broadband carriers already are fully compensated by their residential customers for their use of the network. These companies can charge their own customers whatever they want, in order to make back their investments. Trying to extract additional fees from Web-based companies – who are not in any way “customers” of the provider -- would constitute a form of “double recovery.” **Google takes no issue with the broadband carriers’ ability to set prices for Internet access that compensate for the costs and risks associated with their network investments.**”

Academia: Wu's proposed legal text

§__ Forbidding Broadband Discrimination

(a) Broadband Users have the right reasonably to use their Internet connection in ways which are privately beneficial without being publicly detrimental. Accordingly, Broadband Operators shall impose no restrictions on the use of an Internet connection except as necessary to:

- (1) Comply with any legal duty created by federal, state or local laws, or as necessary to comply with any executive order, warrant, legal injunction, subpoena, or other duly authorized governmental directive;
- (2) Prevent physical harm to the local Broadband Network caused by any network attachment or network usage;
- (3) Prevent Broadband users from interfering with other Broadband or Internet Users' use of their Internet connections, including but not limited to neutral limits on bandwidth usage, limits on mass transmission of unsolicited email, and limits on the distribution of computer viruses, worms, and limits on denial-of-service-or other attacks on others;
- (4) Ensure the quality of the Broadband service, by eliminating delay, jitter or other technical aberrations;
- (5) Prevent violations of the security of the Broadband network, including all efforts to gain unauthorized access to computers on the Broadband network or Internet;
- (6) Serve any other purpose specifically authorized by the Federal Communications Commission, based on a weighing of the specific costs and benefit of the restriction.

(b) As used in this section,

- (1) "Broadband Operators" means a service provider that provides high-speed connections to the Internet using whatever technology, including but not limited to cable networks, telephone networks, fiber optic connections, and wireless transmission;
- (2) "Broadband Users" means residential and business customers of a Broadband Operator;
- (3) "Broadband Network" means the physical network owned and operated by the Broadband Operator;
- (4) "Restrictions on the Use of an Internet Connection" means any contractual, technical, or other limits placed with or without notice on the Broadband user's Internet Connection.

Congressional Attempts

- **Barton Dingell, v1 (9/15/05)**
 - Section 104, “Access to BITS” (Broadband Internet Transmission Service)
 - Essentially Powell’s Four Freedoms, plus duty not to impair interconnection
- **Barton Dingell, v2 (11/03/05)**
 - Section 104 with minor modifications
 - Adds consumer notification requirement regarding “bandwidth or network capacity limitations”
- **Wyden (3/2/2006, voted down)**
 - Extensive and explicit Section 4 “Obligations of Network Operators”
- **COPE (3/27/06)**
 - Primarily about national cable franchising
 - Plus brief Title II giving FCC authority to enforce their broadband policy statement (Martin’s four freedoms as of 8/5/05)