

OPEN INTERNET

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Overview

- Historic background
- Industry structure
- 2010, 2015 & 2017 order
- Basic (rough) legal approaches

A bit of history: Liberalization & CI

- 1956: *Hush-A-Phone* v. US (mechanical attachment)
- 1969: *Carterfone* (connect mobile radio to PSTN)
- 1970: *Open Skies* policy for satellites
- 1966: *Computer I NOI*: “data processing, computer information and message switching services”
- 1970: *Computer I* initial decision → data processing not subject to common carrier rules + “maximum separation” rule
- 1979: *Second Computer Inquiry* → rough division into transport and application
- 1985: *Third Computer Inquiry* → ~~max. separation rule~~
- 1996: codified into 1996 Telecom Act
 - renamed “basic service” → “telecommunication service”
 - renamed “enhanced service” → “information service”



Models for Hand-set Phone



Models for Pedestal Phone

A Telephone Silencer – the HUSH-A-PHONE

A solution of three phone problems of subscribers

Safeguarding Privacy: So others cannot hear confidential matters
Eliminating Phone Talk Annoyances: Quietening the office for personal efficiency
Improving Hearing in Noisy Places: By keeping surrounding noises out of the transmitter
Write for Booklet T-E.

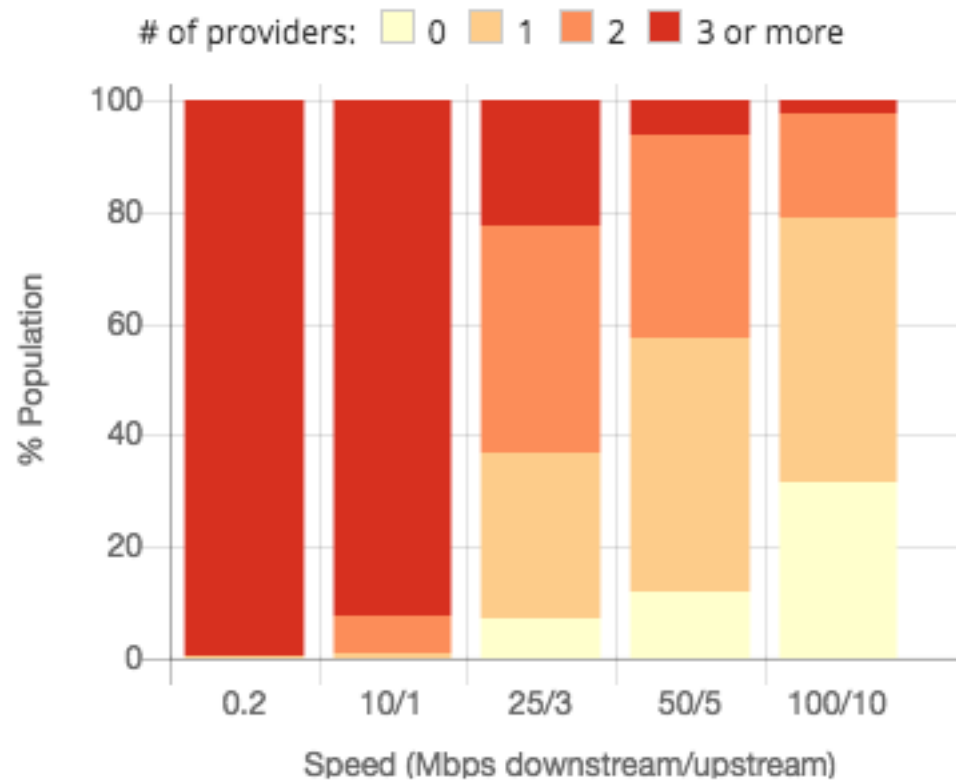
Hush-A-Phone Corporation, 43 W. 16th St., N. Y. City



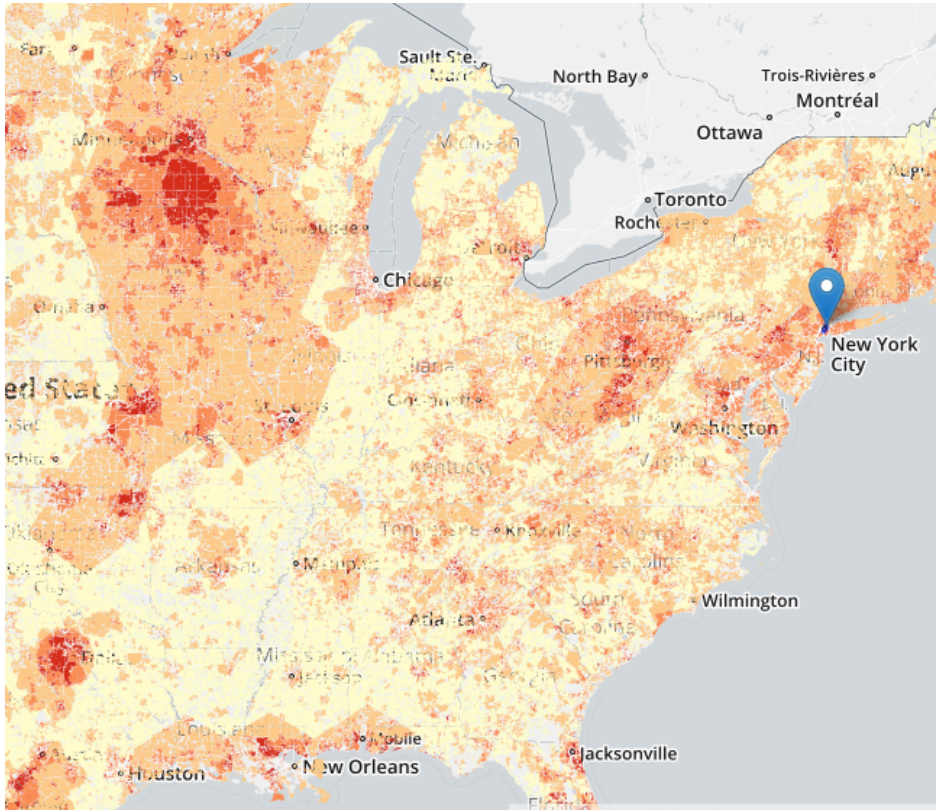
Post-1996

- 2002: *Cable Modem Order* → one information service
 - “like AOL” (IS) = DNS, email, ...
 - 2005: *NCTA vs. Brand X*
- Jun. 2003: Tim Wu “*Network Neutrality, Broadband Discrimination*”
- Feb. 2004: FCC chairman Powell (R) speech
- Aug. 2005: FCC policy statement
- 2005: *DSL Reclassification Order* → parity
- April 2010: DC Circuit: *Comcast v. FCC*
- Dec. 2010: *Open Internet R&O*
- Jan. 2014: DC Circuit: *Verizon v. FCC* – upholds only transparency
- Feb. 2015: *Protecting and Promoting the Open Internet R&O*
- June 2016: *US Telecom v. FCC* – upholds 2015 order
- Dec. 2017: *FCC Internet Freedom R&O* – repeals 2015 order

Competition differs by speed



Competition differs by geography



Advertised Speeds Above 3 Mbps

Data as of: 06/30/14

Verizon Communications Inc.

100 Mbps - 1 Gbps »

Time Warner Cable Inc.

50 - 100 Mbps »

Platinum Equity, LLC

some dubious
(Megapath = business reseller)

25 - 50 Mbps »

Some high-profile cases

- VPN blocking (Comcast, roughly 2001) - unconfirmed
- WiFi blocking (AT&T AUP, 2002)
- Madison River (2005)
 - DSL provider blocked SIP ports
 - fined \$15,000 by FCC
 - based on Section 201 “just and reasonable”
- Comcast (late 2007)
 - insert TCP RST into BitTorrent traffic
 - later overturned on appeal in DC Circuit Court
- RCN (2009): P2P
- Various mobile operators
- Comcast vs. Level 3 (2010, in dispute) - interconnection
- Comcast, Verizon, AT&T, ... vs. Netflix (2013-2014)

Background definitions

- **Telecommunications** = the transmission, between and among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received. (47 U.S.C. § 153(50))
- **Telecommunications service** = “the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used.” 47 USC § 153(46) (1999)
- **Information service** = users of telecommunication services
 - “capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications, and includes electronic publishing, but does not include any use of any such capability for the management, control, or operation of a telecommunications system or the management of a [telecommunications service](#).”
- cf. Basic vs. enhanced service (CI)
 - **Basic telecommunications**: “the offering of a pure transmission capability over a communications path that is virtually transparent in terms of its interaction with customer supplied information.”
 - **Enhanced**: everything else
- **Adjunct services**: directory services

Enhanced service

- “‘enhanced service’ shall refer to services, offered over common carrier transmission facilities used in interstate communications, which employ computer processing applications that act on the format, content, protocol or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different, or restructured information; or involve subscriber interaction with stored information.” 47 C.F.R. § 64.702(a).
- Examples of enhanced services:
 - Internet access service
 - online service, computer bulletin boards
 - video dialtone
 - voice mail
 - electronic publishing
 - The mere fact that a network is packet-switched does not necessarily mean that it is an enhanced service.

Technical problems

- Does not neatly map into engineering (protocol) interfaces
 - Often assumed: Ethernet = “telecom”; IP = “information processing”, but no obvious difference
 - What is “protocol processing”?
 - Traditional telephone applications convert “protocols”, such as ISDN to T1 and formats, such as G.711 A-law to μ -law or G.711 (landline) to G.729 (mobile)
 - Traditional telephony had filters, silence suppression and noise reduction signal processing
- Does not capture control & management explicitly
 - DNS, SS7, BGP
- Upper-layer protocols do not generally transform, either
- Caching services (CDN) vs. “transparent” proxy caches
- Uncommon in other jurisdictions

Definition

- Wu, 2003: “Internet that does not favor one application (say, the world wide web), over others (say, email)”
- Two-sided platform view:
 - providers: “reasonable and non-discriminatory” access
 - consumers: “all of the (legal) Internet”
- Absolute equality of treatment (performance) unlikely
 - TCP is latency-sensitive
 - different applications react differently to impairments (packet loss, delay, reordering, ...)
 - may prohibit quality differentiation by providers
 - → user-chosen quality

What is network neutrality?

- “The principle advocates no restrictions by Internet service providers and governments on content, sites, platforms, the kinds of equipment that may be attached, and the modes of communication.” (Wikipedia)
- 2005 FCC statement (based on 2004 Powell “Internet freedoms”):
 - “access the lawful Internet content of their choice.
 - run applications and use services of their choice, subject to the needs of law enforcement.
 - connect their choice of legal devices that do not harm the network.
 - competition among network providers, application and service providers, and content providers.”
- = *Any lawful content, any lawful application, any lawful device, any provider*

Two views

Open Internet advocates

- no prioritization
- flat rates
- all networks

Free market advocates

- no real problem
- allow any business arrangement
- “it’s my network”
- use anti-monopoly laws if needed
- FTC “unfair & deceptive”

Network neutrality and Title II

2015 order

no QoS
no metering
no zero-rating

§201
§202
§208
§222

tariffs
interlocking directorates
regulated interconnection
§214 discontinuance

no blocking
no paid prioritization
no unreasonable interference
transparency

Why?

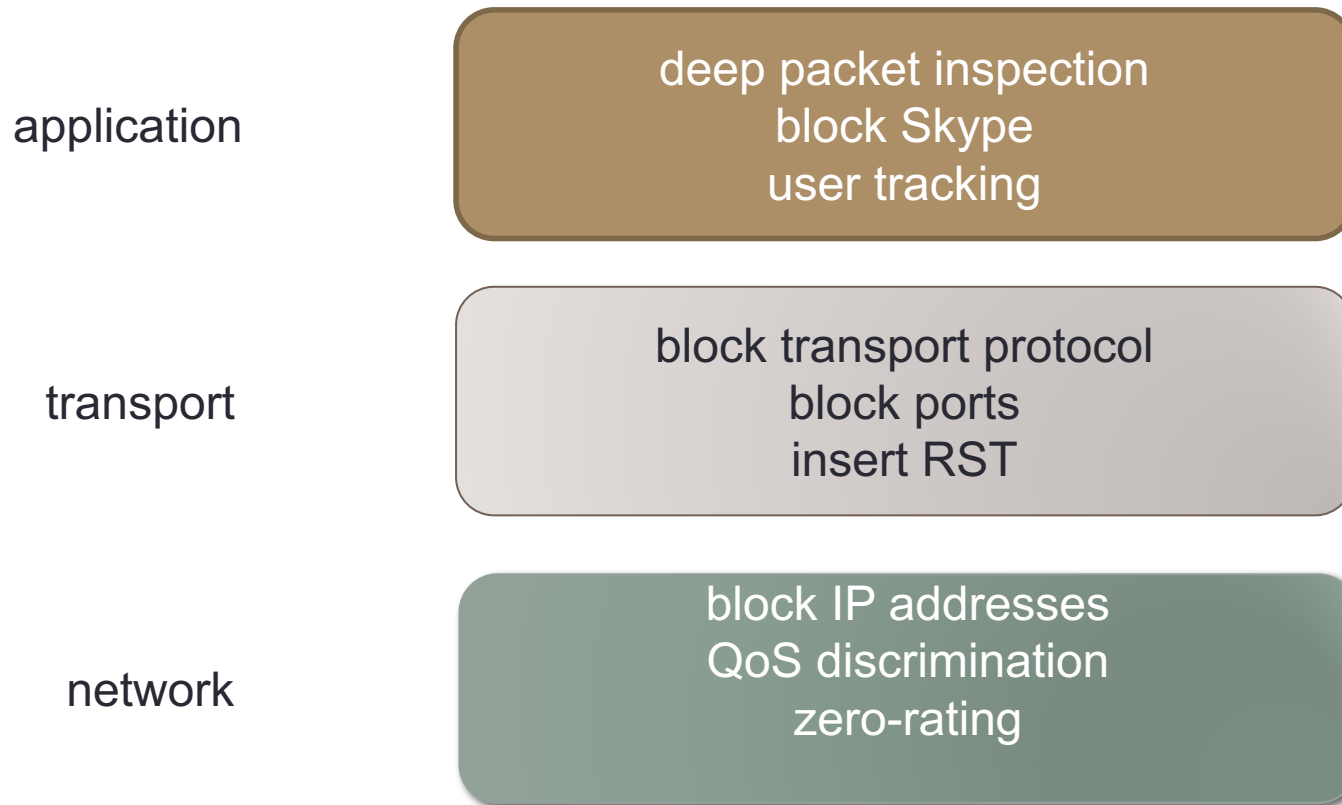
- **Civic considerations**
 - freedom to read (passive)
 - freedom to discuss & create (active)
- **Economic opportunity**
 - edge economy >> telecom economy
 - Telecom revenue (US): \$330B
 - Content, etc. not that large, however
 - Google: \$8.44B
 - others that depend on ability to provide services
 - *content, application, service providers*
- **Technical motivation**
 - avoid network fragmentation
 - reduce work-around complexity

Network neutrality & freedom of speech

1st amendment: Congress shall make no law abridging the freedom of speech

- Applies only to U.S. government, not private entities
 - Example: soap box in city park vs. mall
 - private vs. public universities
- Freedom to speak + no forced speech
 - demise of “fairness doctrine” (1949-1987; formally removed 2011)

How to be non-neutral



Not all practices are necessarily violations

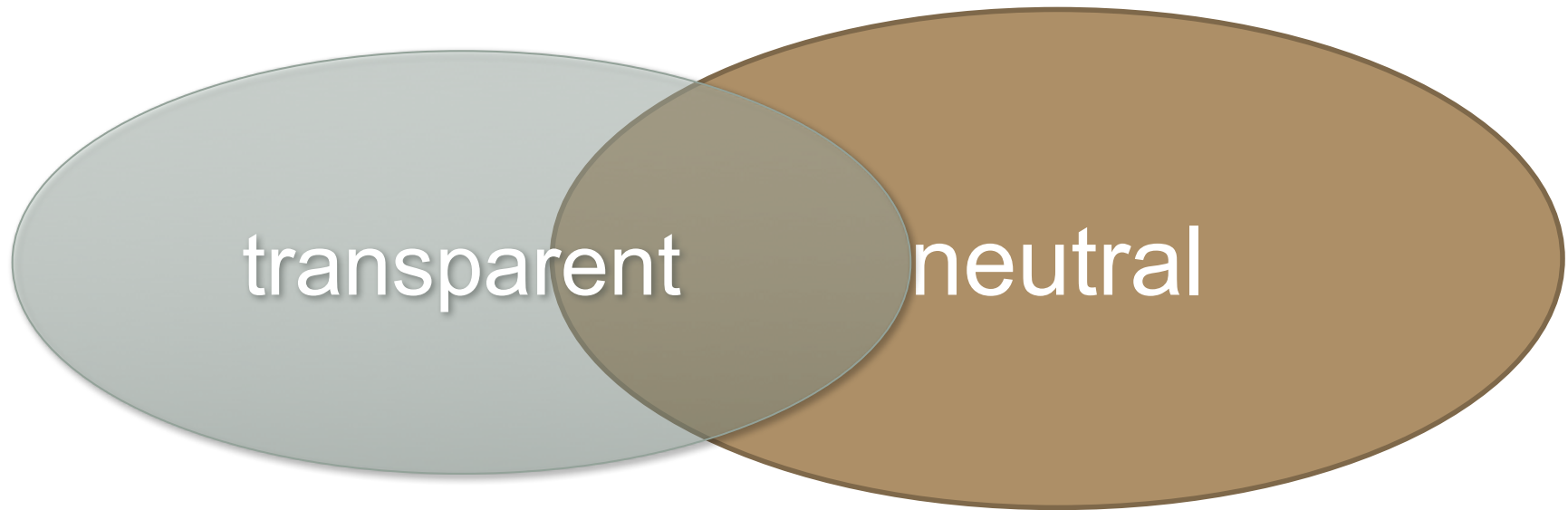
Network transparency

- RFC 1958: “Architectural Principles of the Internet”

However, in very general terms, the community believes that the goal is connectivity, the tool is the Internet Protocol, and the intelligence is end to end rather than hidden in the network.
- RFC 2275: “Internet Transparency”
 - NATs, firewalls, ALGs, relays, proxies, split DNS
- RFC 3724: “The Rise of the Middle and the Future of End-to-End: Reflections on the Evolution of the Internet Architecture”
- RFC 4924: “Reflections on Internet Transparency”

A network that does not filter or transform the data that it carries may be said to be "transparent" or "oblivious" to the content of packets. Networks that provide oblivious transport enable the deployment of new services without requiring changes to the core. It is this flexibility that is perhaps both the Internet's most essential characteristic as well as one of the most important contributors to its success.

Network transparency and neutrality



QoS discrimination
pay for priority

block protocol features

Means, motive and opportunity

- Political motivation
 - suppress undesirable opinion
 - e.g., union web site, abortion SMS
- Economic advantage
 - prevent competition in related services
 - e.g., VoIP or over-the-top VoD
 - leverage pricing power
 - OTT content provider has to offer service to everyone
 - market segmentation
 - consumer vs. business customers
- Non-tariff barriers
 - e.g., special (undocumented) APIs

Are these neutrality issues?

- Redirect DNS NXDOMAIN to ISP web site
- Content translation
 - e.g., reduce image resolution for cellular data
- Blocking transport protocols other than UDP + TCP
- Prohibit web servers for residential services
- Spam filtering
- “KosherNet”
- Reset DSCP (ToS bits)
- Not supporting IPv6
- 3GPP: only make non-BE available to carrier
- “Metered” broadband (“usage-based pricing”)
- Zero-rating of content

Why You Need It

Koshernet provides the ideal, rabbinically endorsed, internet experience for businesses, schools, parents, teachers, or anyone who wants or needs control over exposure to undesirable content during the internet experience.

Optus (Australia) example

\$4.95

n/a

n/a

n/a

- Unlimited access within Australia to Facebook, Twitter, eBay, MySpace, LinkedIn and FourSquare
- No excess usage charges

Best Deal

Over 12 months Min Cost \$54.45
Normally \$59.40

Monthly Access Up to included Value Data (Peak) Data (Offpeak)

1 MONTH FREE ACCESS FEE
Exclusive Online Offer

\$19.95

\$160

Up to
2GB

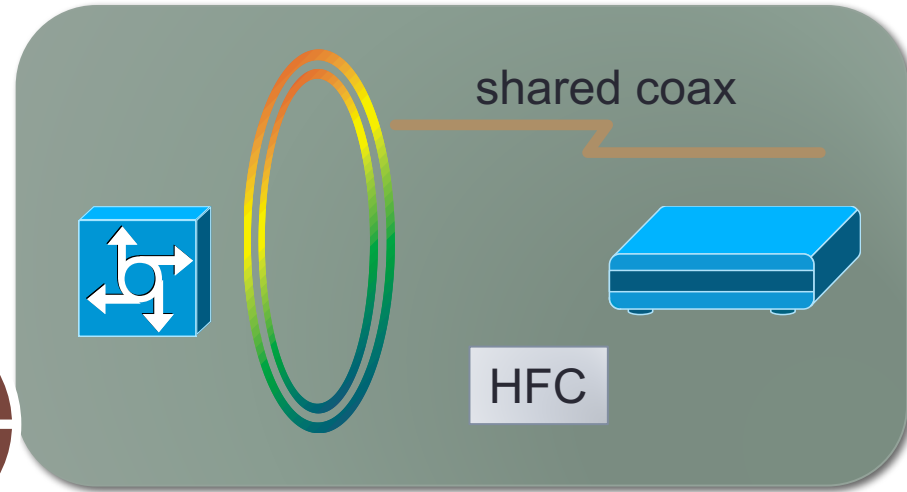
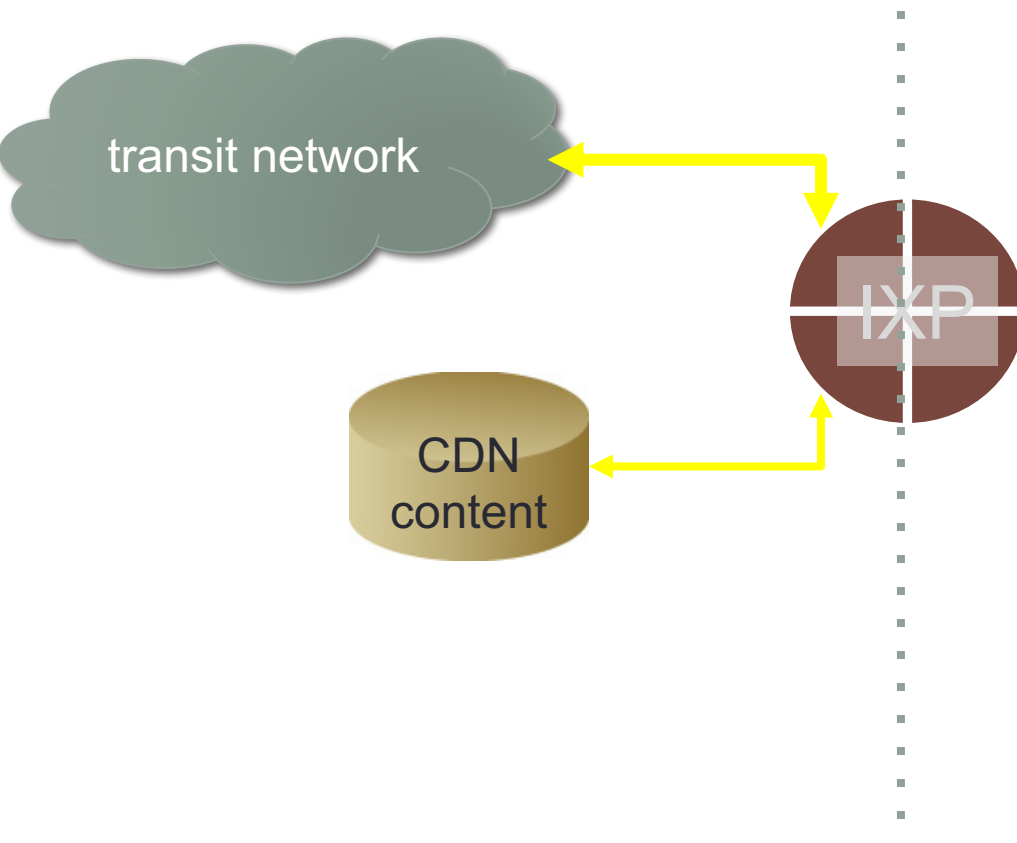
Up to
4GB

- Unlimited access within Australia to Facebook, Twitter, eBay, MySpace, LinkedIn and FourSquare
- 12 months FREE Optus Internet Security Suite
- No excess usage charges

Select

Over 12 months Min Cost \$219.45
Normally \$239.40

Two markets



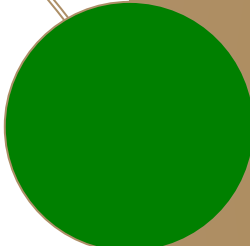
edge-to-BIAS

BIAS-to-consumer

Shared resources

- QoS → generally, protect low-bandwidth, high-sensitivity flows against high-bandwidth, low-sensitivity flows
 - otherwise, reverts to TDM network (lose statistical multiplexing gain)
 - LB QoS: provide quality gain with minimal impact on HB services
- Thus, good for protecting
- QoS does not create capacity
 - thus, if video (40% of peak-hour usage) is prioritized, likely others suffer

Open Internet R&O 2010 + DC Circuit



Transparency. Fixed and mobile broadband providers must disclose the network management practices, performance characteristics, and terms and conditions of their broadband services;



remanded

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



remanded

No unreasonable discrimination. Fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic.

2010 OI R&O: 47 CFR 8

- **§ 8.1 Purpose.**

The purpose of this Part is to preserve the Internet as an open platform enabling consumer choice, freedom of expression, end-user control, competition, and the freedom to innovate without permission.

- **§ 8.3 Transparency.**

A person engaged in the provision of broadband Internet access service shall publicly disclose accurate information regarding the network management practices, performance, and commercial terms of its broadband Internet access services sufficient for consumers to make informed choices regarding use of such services and for content, application, service, and device providers to develop, market, and maintain Internet offerings.

2010 R&O: Disclosure (Transparency) – Network Practices

- *Congestion management*: congestion management practices; types of traffic; purposes; practices' effects on end users' experience; criteria used in practices, such as indicators of congestion that trigger a practice, and the typical frequency of congestion; usage limits and the consequences of exceeding them; and references to engineering standards, where appropriate.
- *Application-Specific Behavior*
- *Device Attachment Rules*
- *Security*

2010 R&O: Disclosure (Transparency) – Performance

- *Service description*: A general description of the service, including the service technology, expected and actual access speed and latency, and the suitability of the service for real-time applications.
- *Impact of specialized services*: If applicable, what specialized services, if any, are offered to end users, and whether and how any specialized services may affect the last-mile capacity available for, and the performance of, broadband Internet access service.

2010 R&O: Disclosure (Transparency) – Commercial Terms

- *Pricing*: For example, monthly prices, usage-based fees, and fees for early termination or additional network services.
- *Privacy Policies*: For example, whether network management practices entail inspection of network traffic, and whether traffic information is stored, provided to third parties, or used by the carrier for non-network management purposes.
- *Redress Options*: Practices for resolving end-user and edge provider complaints and questions.

Verizon holding

- **Upheld** Commission's authority to promulgate Open Internet rules under section 706
- **Upheld** transparency rule
- **Vacated and remanded** blocking and discrimination rules as impermissible common carriage regulation of an information service

Section 706

- (a) The Commission and each State commission with regulatory jurisdiction over telecommunications services shall encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans (including, in particular, elementary and secondary schools and classrooms) by utilizing, in a manner consistent with the public interest, convenience, and necessity, **price cap regulation, regulatory forbearance, measures that promote competition in the local telecommunications market, or other regulating methods that remove barriers to infrastructure investment.**
- (b) ... Commission shall determine whether advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion. If the Commission's determination is negative, it shall take immediate action to accelerate deployment of such capability by removing barriers to infrastructure investment and by promoting competition in the telecommunications market.

Section 706 authority

- **Section 706 is an independent grant of authority**
 - OI Order explicitly rejected *Advanced Services Order* language that 706 “does not constitute an independent grant of authority” → D.C. Circuit satisfied.
- **The Commission had rightly identified harms that fall within the scope of its authority under 706**
 - Virtuous circle (edge innovation drives consumer demand, which stimulates broadband investment, which leads to more edge innovation and investment) is a legitimate reason for promulgating OI rules.
 - Broadband providers have incentives and ability to discriminate against edge providers → prophylactic rules appropriate.

DC Circuit: discrimination rule

- “Little hesitation” in concluding that nondiscrimination rule = common carriage regulation.
- The rule requires broadband providers to offer service to all edge providers → “by its very terms compels . . . providers to hold themselves out ‘to serve the public indiscriminately,’” which is the essence of common carriage.
- Commission never argued that the “no unreasonable discrimination” standard differed from the general nondiscrimination standard that applies to common carriers.

OI NPRM: transparency

- Audience-specific disclosure
 - consumer “nutrition label”
 - include more than just intra-network performance
 - edge providers (CDN, transit providers)
 - performance
 - peering policy?
- Metrics
 - network performance: averages, variability
 - built-in measurements at finer geographic scale
 - bandwidth caps (and tools)
 - N-year cost

ExampleCom Ultra 15 Mbps Broadband Truth-in-Labeling	
Advertised Speed	15 Mbps downstream/2 Mbps upstream
Service Guarantees Services are measured from and to the border router.	
Minimum Speed at Border Router	8Mbps downstream /384Kbps upstream
Minimum Reliability/Uptime	96%
Maximum Round-trip Latency (Delay) to Border Router	50ms
Service Guarantee Terms	Daily service credit upon request for any outages or extended periods of under-delivery of service
Prices	\$44.99 monthly service \$19.99 monthly for the first six months on promotion
Service Limits (List all traffic management techniques)	<ul style="list-style-type: none"> • Exceeding 100GB calendar week considered excessive use, subject to disconnect penalties, see http://www.examplecom.invalid/excessive • Traffic by heavy users in congested areas is artificially slowed, see http://www.examplecom.invalid/shaping
Other Fees (ISPs cannot charge if not listed)	\$3 monthly modem rental fee \$59.99 installation fee \$19 outlet installation \$150 early termination during promotion period \$2 account change fee \$35 service call fee unless \$3 monthly inside wiring maintenance plan is in force Sales taxes and franchise fees, vary by location
Contract Term	At will, customer may cancel at anytime after first six months. During the first six months, a cancellation results in a \$150 fee.
Service Technology	DOCSIS 1.1 / 2.0 HFC
Legal and Privacy Policies	http://www.examplecom.invalid/legal

New America Foundation
example

2015 OI rules

- No blocking
 - “A person engaged in the provision of broadband Internet access service, ..., shall not block lawful content, applications, services, or non-harmful devices, subject to reasonable network management.”
- No throttling
 - “... shall not impair or degrade lawful Internet traffic on the basis of Internet content, application, or service, or use of a non-harmful device, subject to reasonable network management.”
- Paid prioritization
 - “... shall not engage in paid prioritization.”
 - “... not unreasonably interfere with or unreasonably disadvantage (i) end users’ ability to select, access, and use broadband Internet access service or the lawful Internet content, applications, services, or devices of their choice, or (ii) edge providers’ ability to make lawful content, applications, services, or devices available to end users.” (peering)
- General conduct rule
- Enhanced transparency

2015 OI rules

- telecommunication services – Title II
 - defines PSTN as including data services
 - includes mobile & fixed
- Sections 201, 202 & 208 apply
- but others forborne

Excluded (2010 & 2015)

- enterprise services
- virtual private network services, hosting, or data storage services
- premises operators
 - coffee shops, hotels, Amtrak, airlines, ...

2017 OI rules

2017 justifications

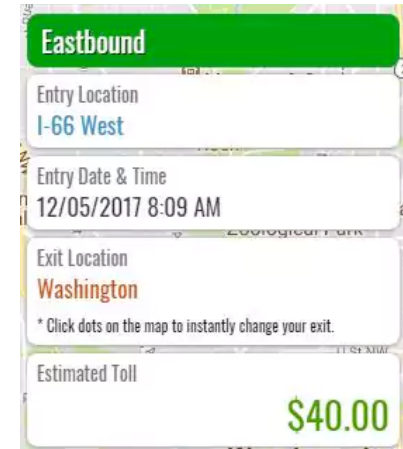
- decrease in investment
- Internet service is technically an information service
 - DNS and caching
- FTC and anti-trust laws can deal with any anti-competitive behavior

What could “fast lane” mean?

- Separate mechanism from who pays
 - e.g., customer buys “commercial-grade” service (SLA)
 - edge provider pays
- Separate logical IP-based “pipe” to end user
 - e.g., U-Verse “cable TV” video delivery
 - may be faster than broadband Internet service
- Resource reservation
 - guaranteed bandwidth (e.g., similar to MPLS CIR)
- Scheduling or drop priority
 - priority packets get priority access to shared resources
- Impact on best-effort services
 - well-provisioned vs. artificial starvation

The problem with analogies

- “Fast lane”
 - like HOV lane on highway?
 - or paid I495 “Lexus lane”?
 - implicitly assumes that congestion is normal and unavoidable
 - confused with different consumer subscription levels
 - Google 5/1 service is “slow lane”
 - unclear whether impairment is
 - artificial → induce upgrade



With a rush-hour toll of \$1.75, the 4 toll lanes will carry less than 7% of the total traffic on the 12-lane highway. Truck drivers will avoid them, the Maryland Transportation Authority's consultants say, "due to the minimal benefit for trucks in saving small amounts of time." Except during exceptional traffic jams, nearly the only users will be drivers affluent enough not to care much about the toll, leading some to call them "Lexus lanes."

Range of concerns



Differentiation universe

Behavior	Content-neutral	By content type	By edge provider
Packet dropping, RST, delay		P2P	VoIP (non-US)
Limit flow bandwidth (e.g., 10 Mbps/flow)	TMo: reduce speed after cap		
Specialized service			BIAS or affiliated
Interconnection	refuse all peering		Cogent, Level3, Netflix
Bandwidth cap (e.g., 10 GB/month)		Satellite (count only video)	AT&T proposal
App restrictions		ISIS payment app bootloader	FaceTime

Specialized services

- R&O 2010: “services that share capacity with broadband Internet access service over providers’ last-mile facilities”
 - FCC OIAC report noted definitional difficulty
 - separate logical facilities?
 - cannot reach almost all IP addresses?
- EuP 2014: “an electronic communications service optimised for specific content, applications or services, or a combination thereof, provided over logically distinct capacity, relying on strict admission control, offering functionality requiring enhanced quality from end to end, and that is not marketed or usable as a substitute for internet access service.”

Specialized services

- What's the difference to offering a “fast lane”?
- Definitional
 - only available to facilities-based provider (but not restricted)
 - doesn't provide access to whole Internet
 - would include CDN and Netflix deals
- Capacity impact
 - reduce investment into general-purpose Internet
 - or encourage benign neglect (middle mile, peering, ...) → US DSL
- Remedies
 - treat “specialized service” as catch-all non-BE service class subject to “commercially reasonable” restrictions

Sampling of options

- Do nothing
 - wait for Congress rewrite of Communications Act
- Section 706
 - “commercially reasonable” (like data roaming)
 - do not favor own content (AT&T)
- Hybrid Title II + 706
 - Narechania & Wu, Mozilla: for backbone-facing side
 - “fail safe”
- Full Title II
 - with forbearance

Other issues

- Device attachment & software apps
 - Can a provider prevent use of software, such as tethering or video apps?
 - Alternate boot loader and OS versions?
- Privacy
 - ISP tracking of user activity: IP addresses visited
 - direct usage (ad placement)
 - Verizon “super cookie” & AT&T pay-for-privacy
- Zero rating
 - most controversial practice: consumer benefit vs. competition harm
 - see Jan. 9, 2017 FCC WCB report (rescinded Feb. 3, 2017)

WCB zero-rating report

- Overall considerations
 - Is the BIAS provider altering or influencing the unfettered flow of lawful Internet traffic between edge providers and end-users?
 - Does the activity or practice in question have the effect (implicit or explicit) of favoring services provided by its affiliates, creating exclusionary relationships that benefit only selected edge providers, discriminating on the basis of content or other improper basis?
- Non-discrimination
 - Is zero-rating available, or available on materially favorable terms, only for a service directly affiliated with the BIAS provider?
 - Does the zero-rating plan create exclusionary arrangements between the BIAS provider and unaffiliated content providers that raise reasonable competitive concerns from excluded parties?
 - If a BIAS provider charges edge providers to be zero rated, are those charges imposed on affiliated and unaffiliated entities effectively on a non-discriminatory basis?

WCB zero-rating report

- Data cap
 - Is the associated data cap sufficiently high as to make all data effectively zero-rated for the overwhelming majority of customers, both on a static and forward-looking basis, such that consumers really are not facing a choice between zero-rated and non-zero-rated activity?
- Choice and End User Control
 - Do consumers and edge providers have the ability to easily opt into and out of the zero-rated plan if they prefer to remain with offers in line with those available at the time the plan was introduced, or to control other aspect of using the zero-rated service?
 - Do consumers have easy alternatives for switching to other BIAS providers with different zero-rating practices?

Example zero-rating plans

- T-Mobile BingeOn
 - November 2015
 - streaming video services that meet certain technical standards
 - participating edge providers can offer to T-Mobile's mobile broadband subscribers zero-rated video programming at 1.5 Mbps or 480p+/DVD quality
 - no charge to providers
 - no affiliated content
- AT&T Data Perks
 - reward for engaging in broadband activities that typically involve smaller amounts of data, such as purchasing products
- AT&T Sponsored Data
 - enables edge providers to supply streaming video programming and other content and edge services to AT&T's mobile broadband consumers on a zero-rated basis
 - zero-rate affiliated programming to its AT&T Mobility customers on its DIRECTV App and its DirecTV Now over-the-top video product
- Verizon FreeBee Data 360
 - edge providers to pay on a per-gigabyte-used basis
 - zero-rate Go90
- Comcast Xbox streaming