The Transition to IP Telecom: Evolution, not Revolution

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presentation sponsored by the

Division of Ratepayer Advocates
California Public Utilities Commission
San Francisco
June 16, 2010

From the Telegraph to IP:
The Evolution of Telecom Technology

The evolution of telecom technology







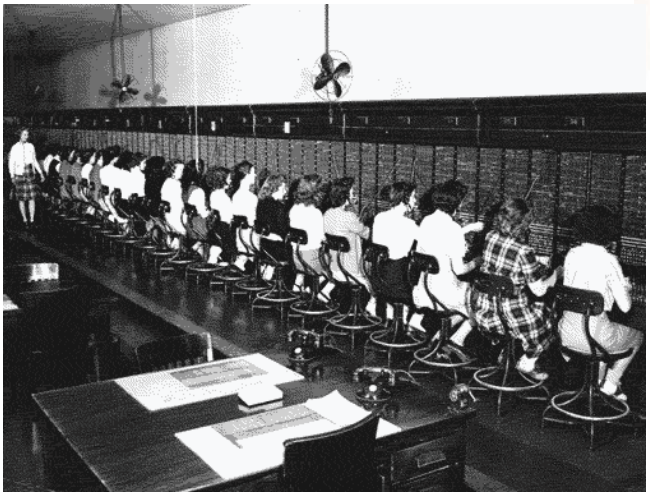






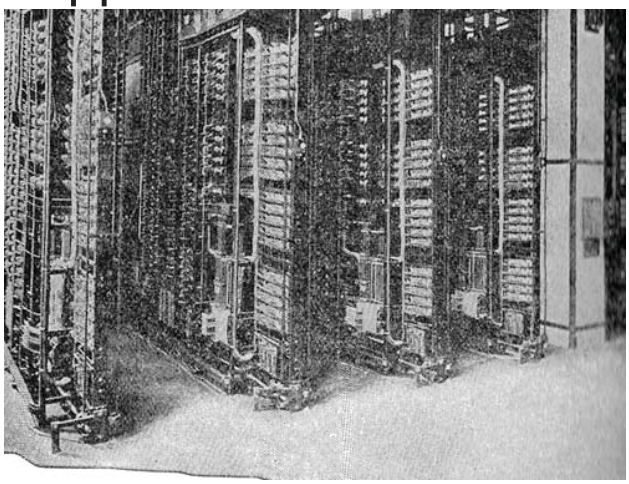
The evolution of telecom technology

- DC Copper loop / manual cord switchboards



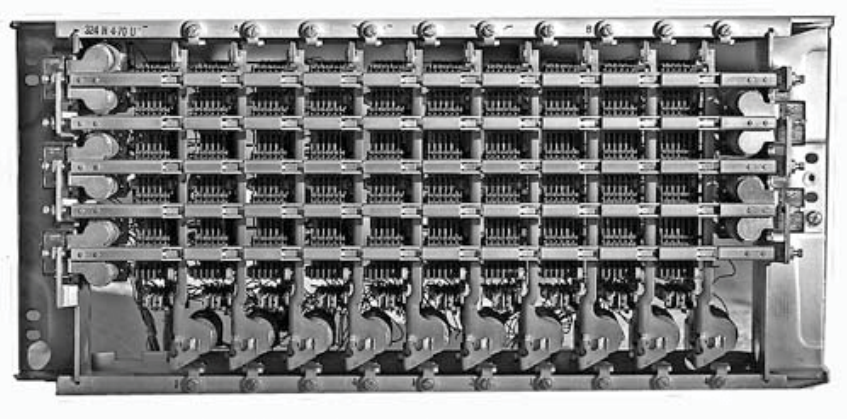
The evolution of telecom technology

- DC Copper loop / step-by-step electromechanical central office switches ‘ amplified copper interoffice trunks



The evolution of telecom technology

- DC Copper loop / crossbar electromechanical central office switches / frequency-division multiplexed (FDM) carrier system using coax and microwave



The evolution of telecom technology

- DC Copper loop / analog space-division electronic switching / time-division multiplexed (TDM) interoffice carrier systems using copper, coax, microwave / multi-frequency interoffice signalling

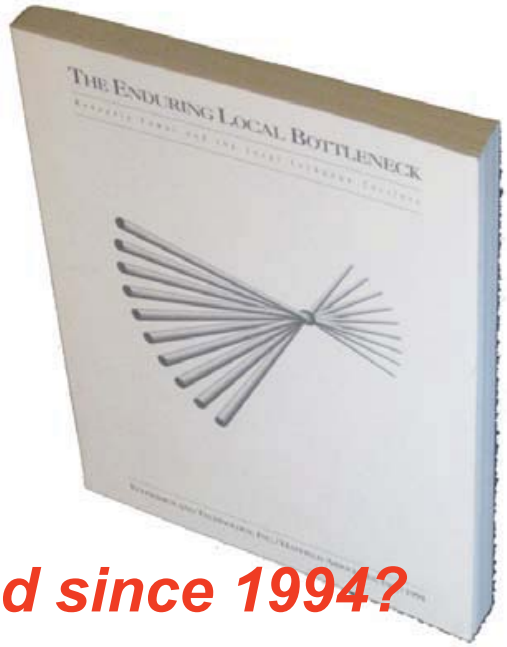
The evolution of telecom technology

- TDM-based access lines capable of carrying multiple lines/trunks / digital electronic switches / high-bandwidth fiber optic TDM interoffice carrier systems / “common control” interoffice signaling

The evolution of telecom technology

- Digital “last mile” access connections (DSL, cable modem) / packet-based IP transmission and switching / “connec-tionless” IP-based signaling (ATM, Ethernet, DOCSIS) / Domain Name Service (DNS) routing

1994: AT&T and MCI engage ETI and Hatfield Associates to prepare a detailed economic and technical analysis of "The Enduring Local Bottleneck"



Has anything changed since 1994?

The enduring bottleneck

- Incumbent carriers have long argued that economic and regulatory models applicable to legacy telecom services cannot be used for "advanced" "next generation" "IP-based" services because these are somehow fundamentally different.
- They are wrong.
- IP and similar "packet" protocols are merely the latest stage in an evolutionary process that dates back to the earliest telegraph, or even earlier.

The enduring bottleneck

- All require “last mile” connections to end users – ubiquitous infrastructures characterized by high fixed costs, substantial economies of scale, and (in residential and rural areas) low density.
- Extreme network externalities – value of network membership increases exponentially as number of members grows
- “Last mile” monopoly can be easily extended into adjacent and potentially competitive network components and vertical (downstream) markets

The enduring bottleneck

- That “last mile” link between the end user and the serving local telecom provider is a physical (wireline or wireless) connection whose economic properties are largely unaffected by the particular transmission protocol that such a facility carries.

The enduring bottleneck

- Where “bottlenecks” or “chokepoints” are present, the entity that controls them can – absent regulatory constraints – leverage that position so as to exert market power in adjacent – and otherwise competitive – upstream and downstream markets.

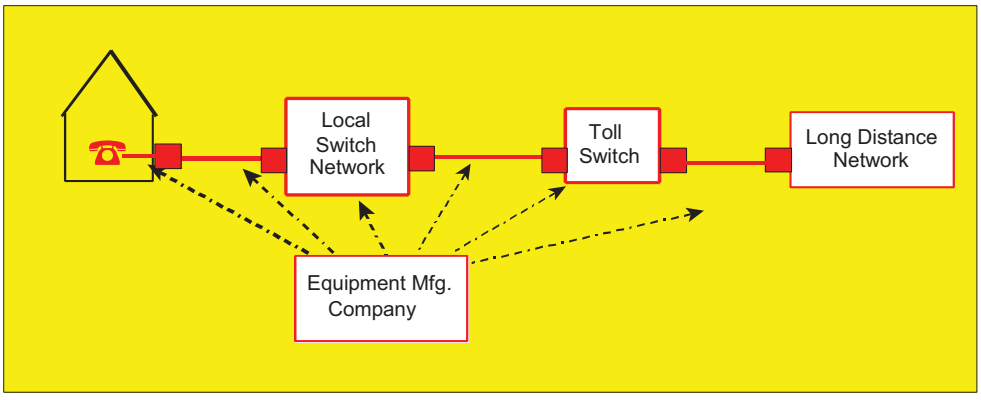
The “Enduring Local Bottleneck” in the PSTN World

The evolution of telecom technology

- The "enduring local bottleneck" in the circuit switched (PSTN) world:
  - Pre-1970: AT&T/Bell System controlled telecom end-to-end, including CPE, inside wiring, equipment manufacturing
  - Post-1984: Bell companies controlled local service from Network Interface at customer premises through hand-off to IXC at tandem
  - Today: Only "monopoly" left is the wireline access link from customer to service provider

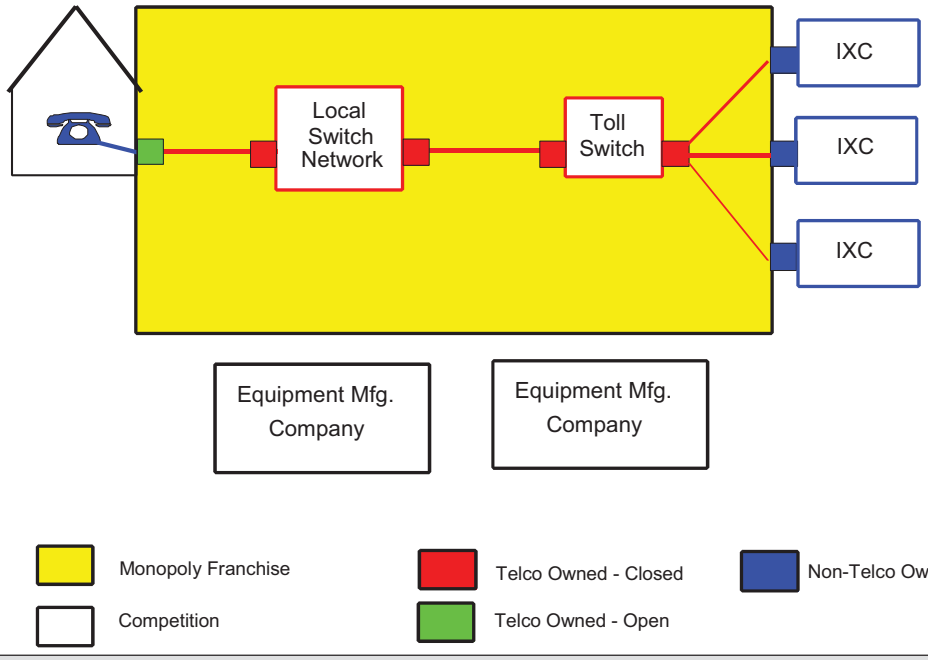
The Shrinking Natural Monopoly: Pre-Carterphone (before 1970)

Pre - Carterphone



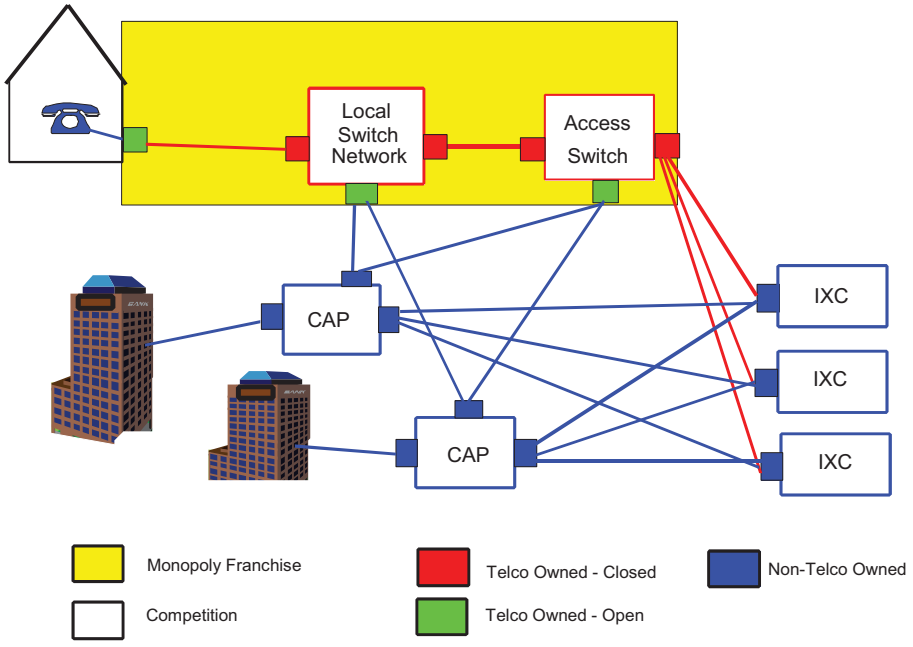
The Shrinking Natural Monopoly: Following 1984 break-up of AT&T

Post - Divestiture

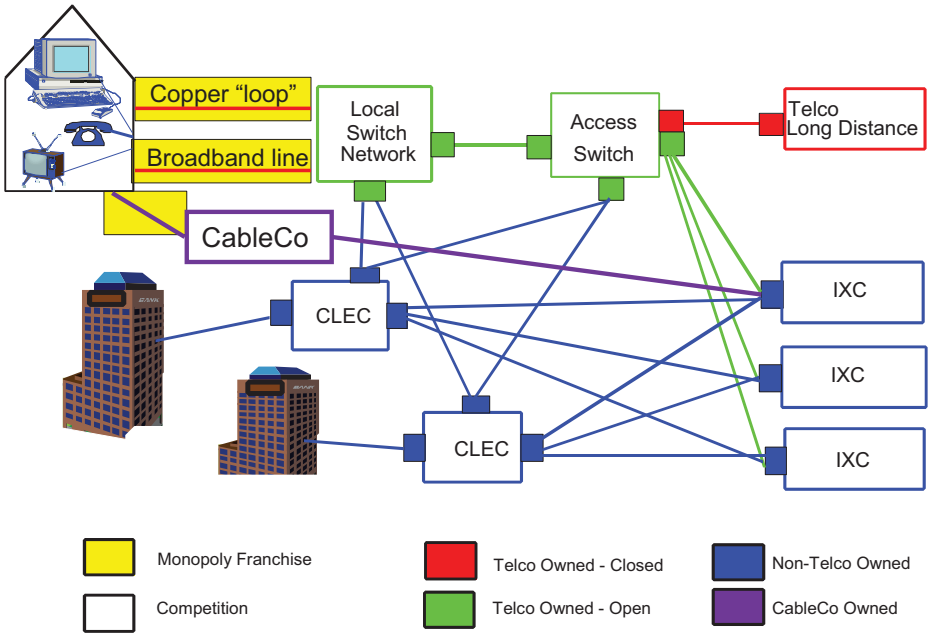


The Shrinking Natural Monopoly: as envisioned by TA96

Today



The Remaining Natural Monopoly



The "Enduring Local Bottleneck" in the IP World

The evolution of telecom technology

- Does IP alter the fundamental economics of telecom?
  - Not as much as you might think
- The core question remains: Will any "bottlenecks" or "chokepoints" exist in an IP-based telecom environment?

The evolution of telecom technology

Does IP really change anything?

- ILEC or cableco still provides physical link between end user and wire center or "head-end" – an effective duopoly in most markets
- ILEC or cableco still maintains absolute control over who gains access to its end users
- Potential use of wireless "last mile" link – only practical in a limited number of cases, not yet a true competitor to wireline
  - Besides, who owns the largest wireless carriers?

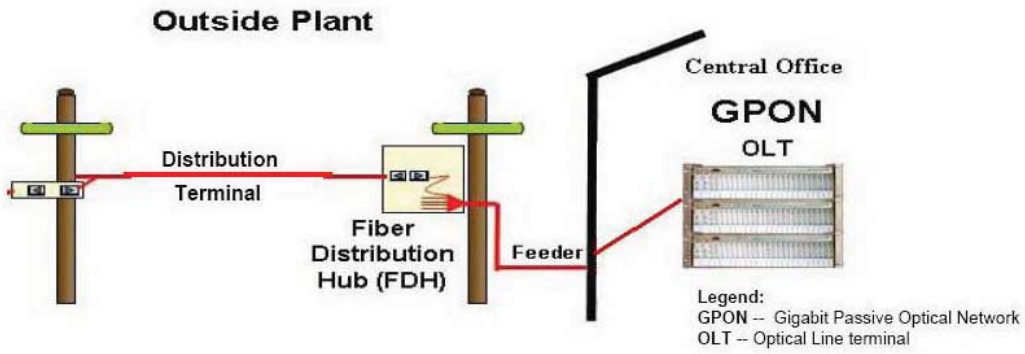
The economics of broadband

- Contrary to popular "folklore," last mile broadband networks exhibit the same economic properties as last mile narrow-band legacy networks:
  - High fixed costs
  - Massive economies of scale
  - Low demand, low revenue opportunities on most individual last mile network links
  - Network externalities affecting supply and demand
- Result: High market concentration, minimal or no competition for last mile access connections

The economics of broadband

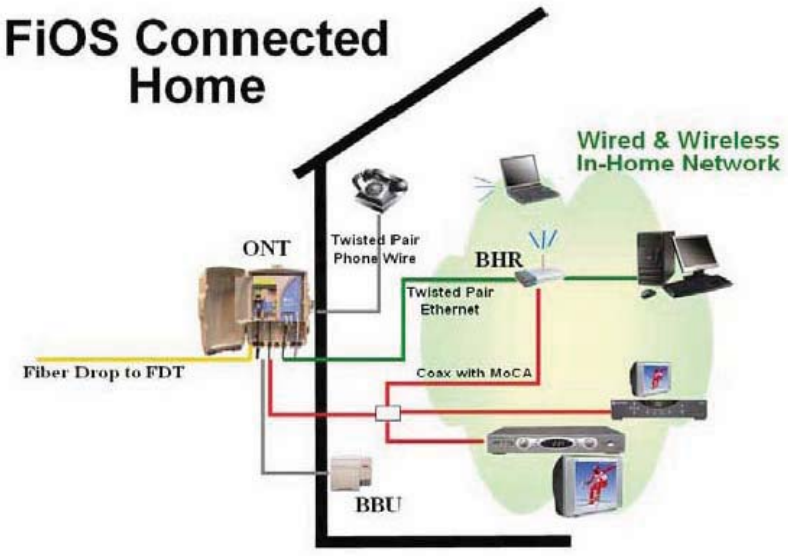
- Recent FCC "Broadband Workshops" have shed additional light on the economic challenges facing ILEC broadband initiatives – particularly Verizon's FiOS
- ILECs' costs per home passed and per home connected are substantially higher than those facing cablecos going forward.
- It's hardly surprising that Verizon has decided to shut down further FiOS expansion and just harvest what's already in place.

The economics of broadband



Source: Verizon *ex parte* submission to FCC, GN Docket 09-51, August 27, 2009

The economics of broadband



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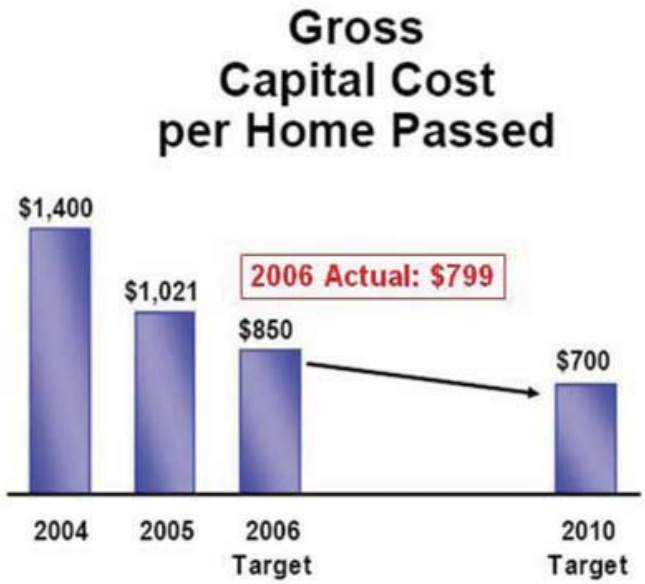

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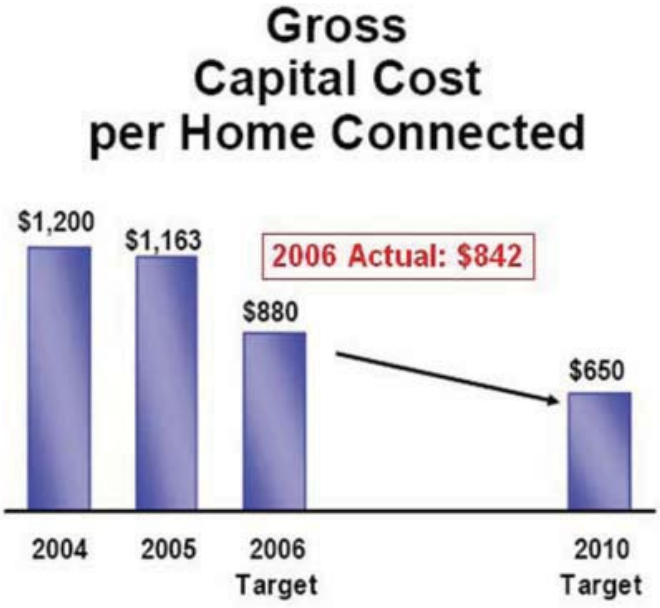

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The economics of broadband

VZ's costs critically depend on FiOS take rate:

	UNIT COST	20% Take Rate	30% Take Rate
Capital cost per home passed	$ 799	$ 3995	$ 2663
Capital cost per home connected	$ 842	$ 842	$ 842
Cost of acquisition (estimate)	$ 600	$ 600	$ 600
Total cost per customer connected		**$ 5437**	**$ 4105**

Data Source: Verizon *ex parte* submission to FCC, GN Docket 09-51, August 27, 2009

The economics of broadband

- If we (very conservatively) assume that VZ's annual capital-related costs (cost of capital, depreciation, maintenance) are 24% of capital investment, and that ongoing annual SG&A costs are 12% of capital investment, then …
  - At a 20% take rate, VZ would need at least $163 per month per customer just to barely break even.
  - At a 30% take rate, that figure would still be $123.
- And these figures do not include payments by VZ for video and other content-related services
- Nor do they account for potential downward pressure on prices as cable responds to FiOS share growth

The economics of broadband

- Most cable broadband Internet Access investment has already been made – and at much lower cost than for FiOS.
- Cable's cost per net additional customer is likely well under $1000.
- Break-even revenue needs both for added and for existing customers are much less than those facing VZ.
- (AT&T's hybrid fiber/copper/coax approach is much closer to cable architecture than is FiOS)

The economics of broadband

- FiOS might make economic sense, but only if Verizon
  - Can find additional sources of revenue, such as access fees from content providers to reach FiOS households
  - Can convince most existing cable broadband customers to switch to FiOS
  - Can bring its capital and acquisition costs way down
  - Can raise prices and develop new sources of revenue from its FiOS customers via measured use charges, fees for premium services, etc.
- Net Neutrality requirements will greatly undermine VZ's ability to exploit its customer relationships to develop these additional revenue sources – hence its strenuous opposition.

The economics of broadband

- Verizon's decision to shut down further FiOS investment confirms folly of original business model:
  - By the end of 2010 VZ will have invested some $23-billion and will pass 18-million homes.
  - However, FiOS TV connections are running at around 3-million, with FiOS internet about a half million more.
  - If you divide the $23-billion by the 3-million actual FiOS customers, that works out to more than $7,000 per connected customer.

The economics of broadband

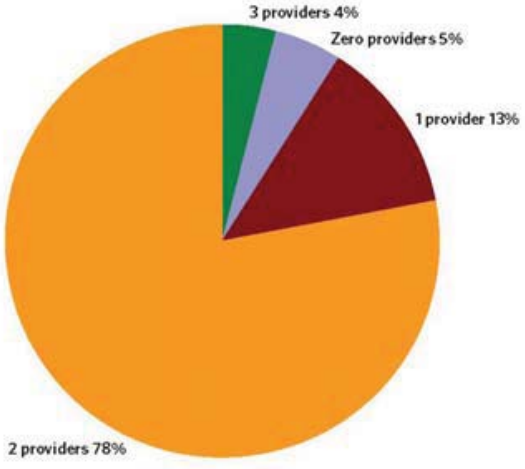
- The $23-billion / $7,000 per connected FiOS customer probably does not include:
  - costs of customer acquisition
  - ongoing operating costs including -- in the case of TV -- costs of acquiring content
  - Effects of customer churn
- To break even,VZ would need to generate at least $200 per month per subscriber -- maybe even more
- Obviously highly unrealistic, particularly when cable's incremental capital costs per incremental subscriber are likely well below $1,000

The economics of broadband

- AT&T's approach to broadband is far less ambitious and far less costly that Verizon's
  - But its costs are still a good deal higher than cable's
- And when compared with cableco broadband services, AT&T's architecture will at best produce a "me too" result
- So is there any real prospect for serious competition in mass market broadband access?

The economics of broadband

- Share of Housing Units in Census Tracts with 0, 1, 2, and 3 Wireline Providers



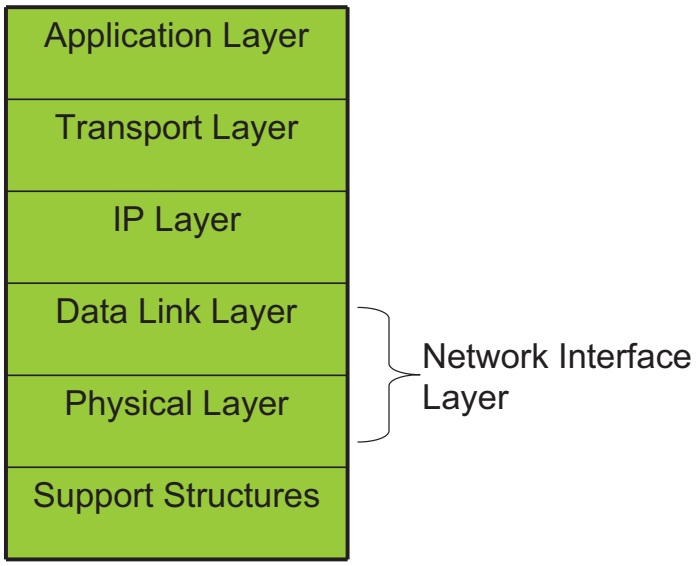
Source: FCC National Broadband Plan

The economics of broadband

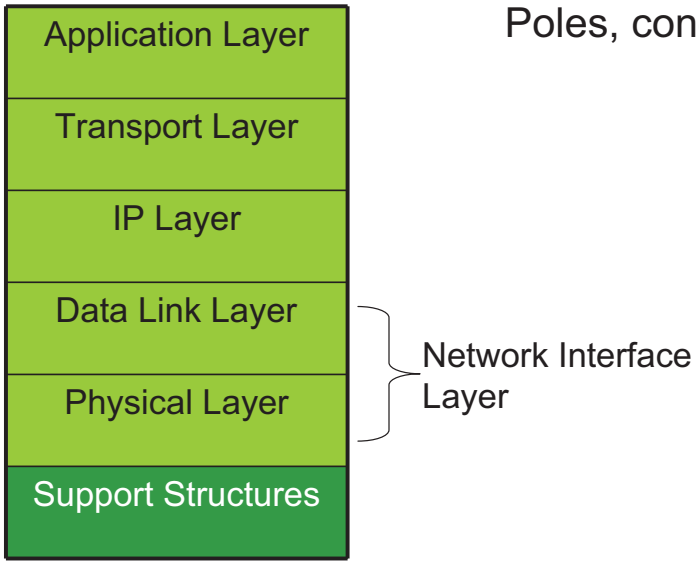
- At the end of the day, we end up with at best a duopoly but potentially a monopoly in the provision of mass market broadband access
- So are we basically right back where we started?
- Yes – except now the duopoly or monopoly provider is *unregulated*!

IP Network Architecture: Identifying the "Monopoly" and "Competitive" Components

The TCP/IP Protocol Suite

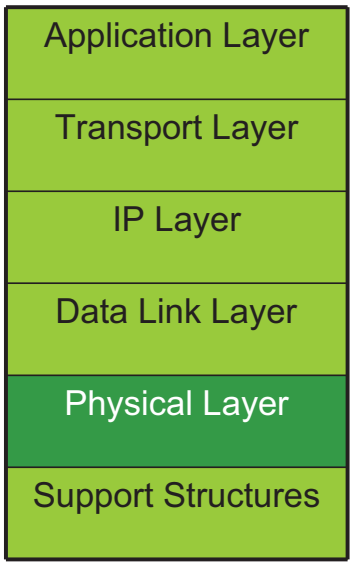


The TCP/IP Protocol Suite



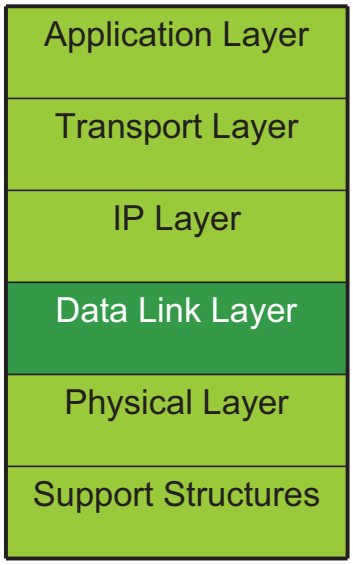
Poles, conduit, cell towers, etc.

The TCP/IP Protocol Suite



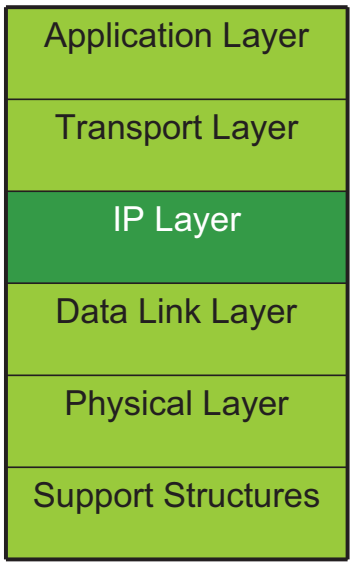
The actual medium used by the data link level – e.g., twisted pair copper, coaxial cable, fiber optic cable, or radio spectrum.

The TCP/IP Protocol Suite



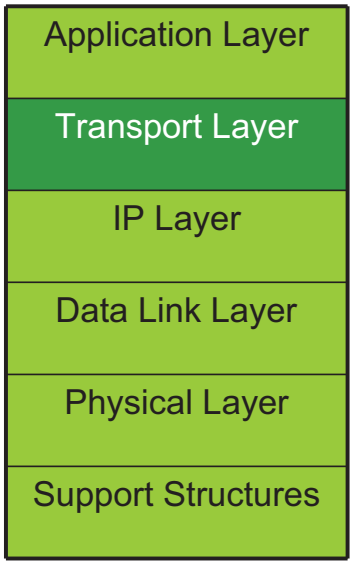
Transmits the IP packet over the physical layer via any of several IP protocols – e.g., ATM, Ethernet, DOCSIS, or WiFi

The TCP/IP Protocol Suite



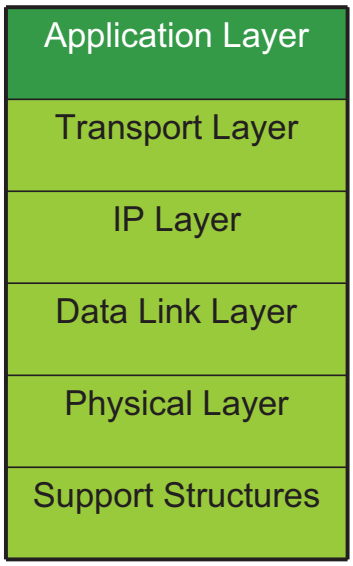
Routing of packets through networks -- the associated software resides in devices (e.g., computers) at the edge of the network and in routers at nodes throughout the network.

The TCP/IP Protocol Suite



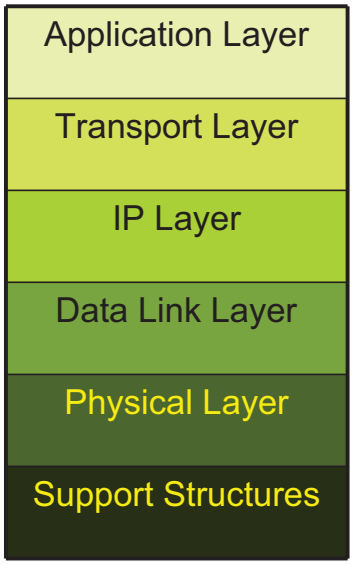
Performs such sub-functions as setting up connections between computers and for error and flow control.

The TCP/IP Protocol Suite



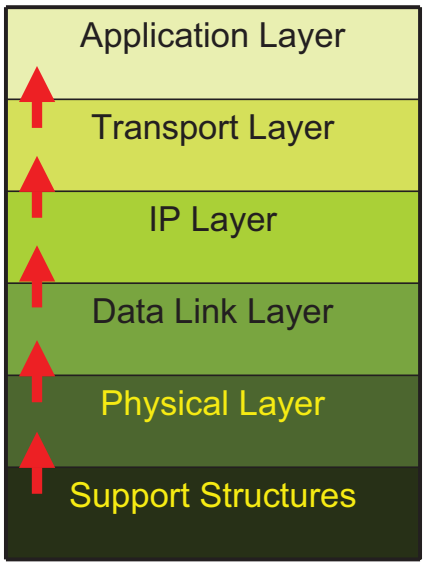
Services like e-mail, chat / instant messaging, social networking, web searching, music sharing, IPTV, and the World Wide Web

The TCP/IP Protocol Suite



Market concentration is greatest at the lower levels of the protocol stack – the higher up, the greater the potential for competition

The TCP/IP Protocol Suite



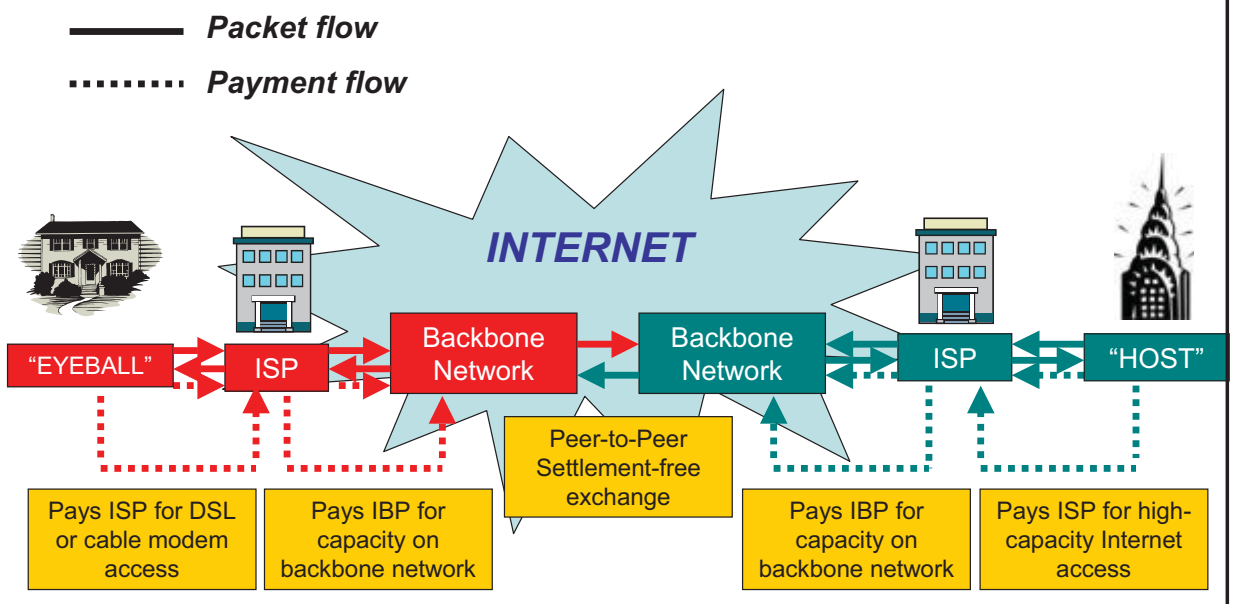
- Activity at each level requires access to the next lower level
- An entity that has market power at any given level can leverage that market power into the next higher level
- And so on …

Market concentration in the IP world

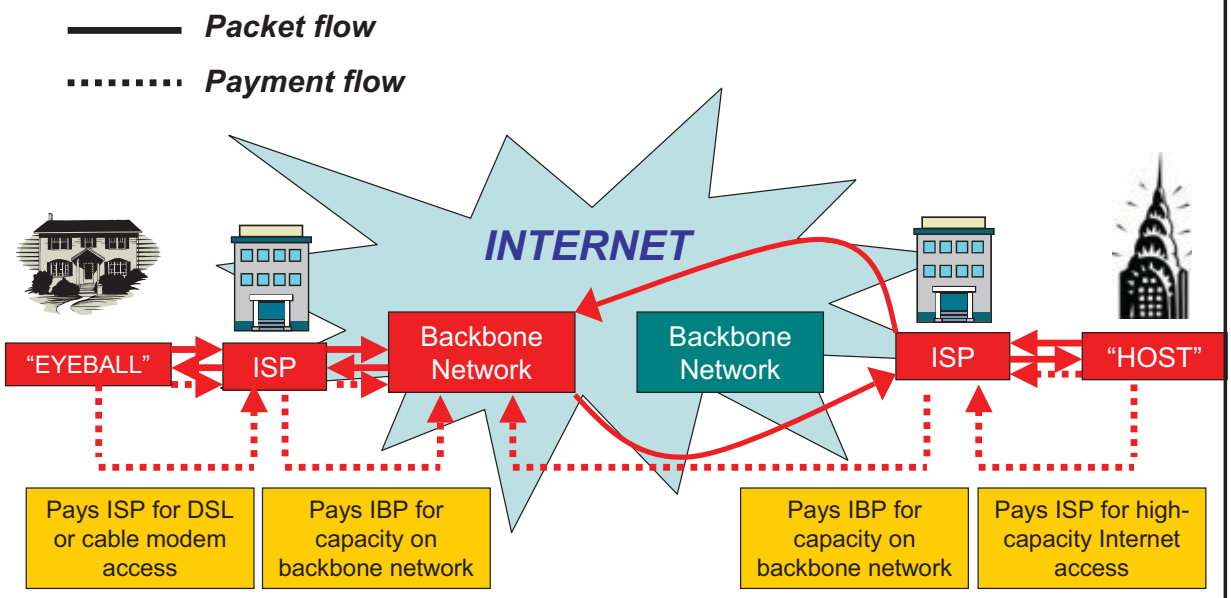
Market concentration in the IP world

Leveraging market power
to control upstream markets

The Internet Backbone: Today

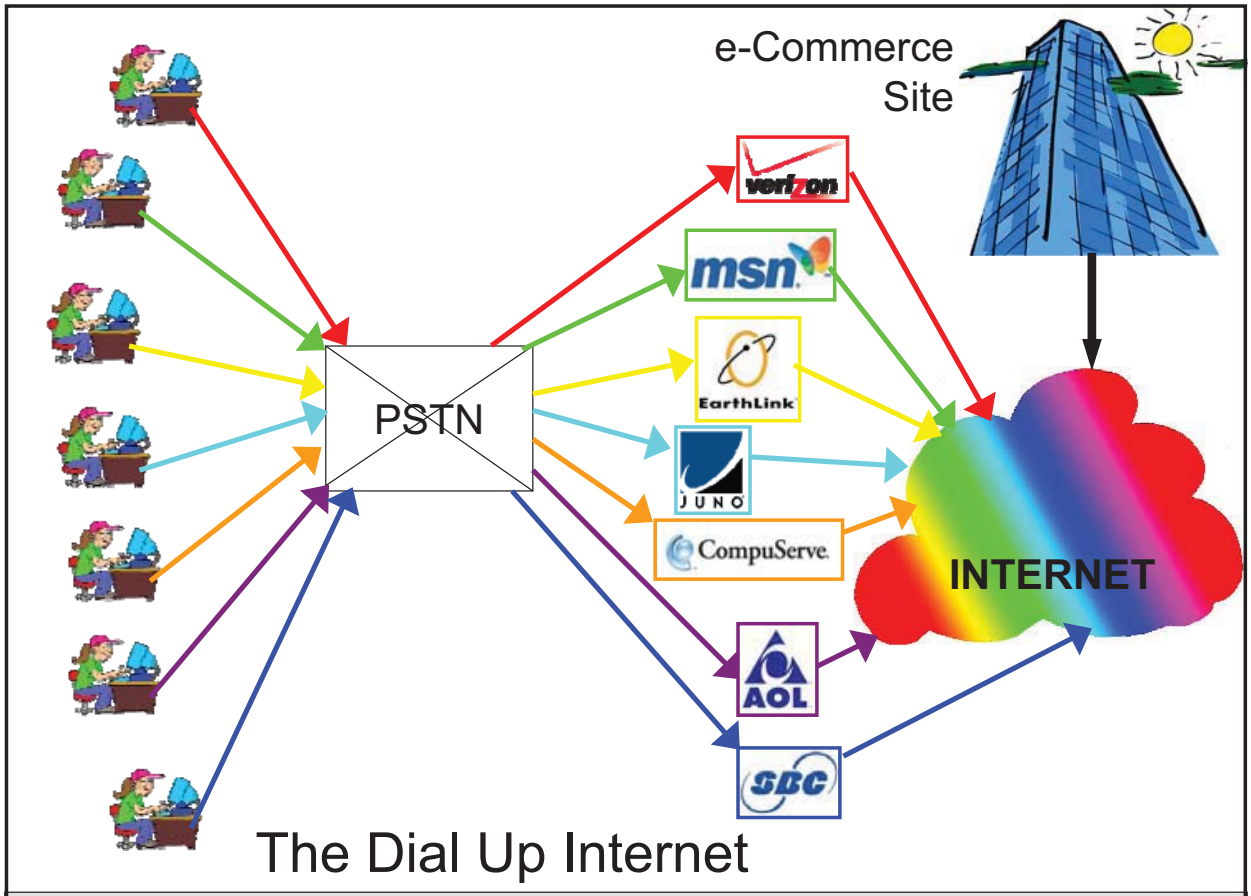


The Internet Backbone: Net neutrality, peering eliminated



Market concentration in the IP world

Leveraging market power
to control downstream markets

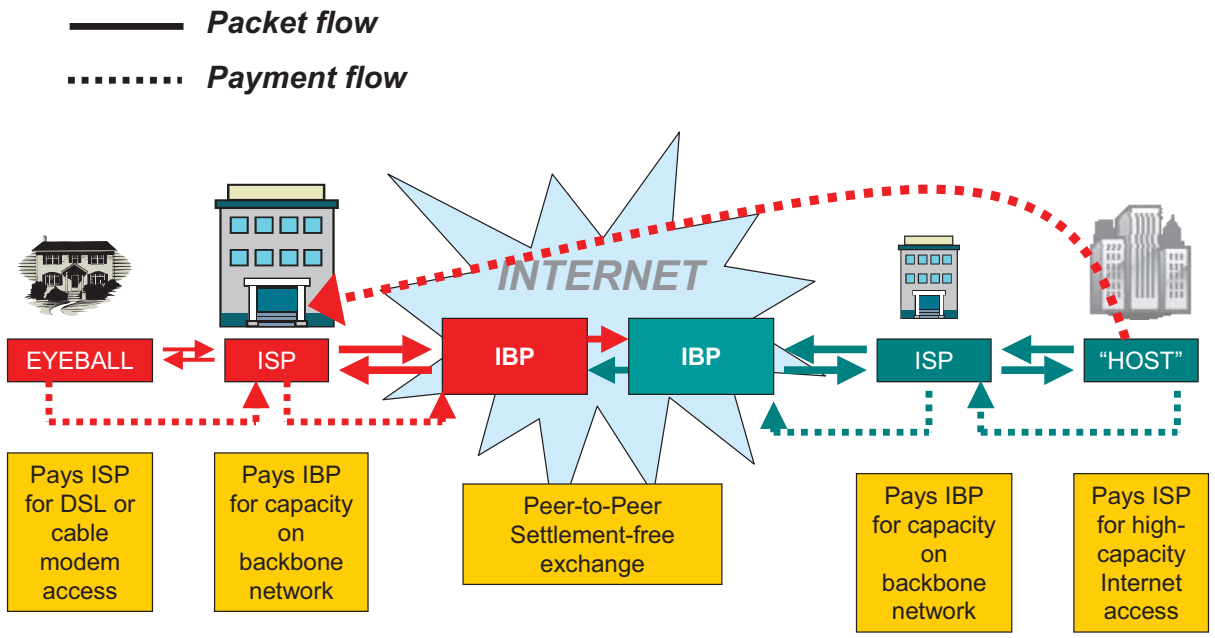


The Dial Up Internet

The enduring bottleneck

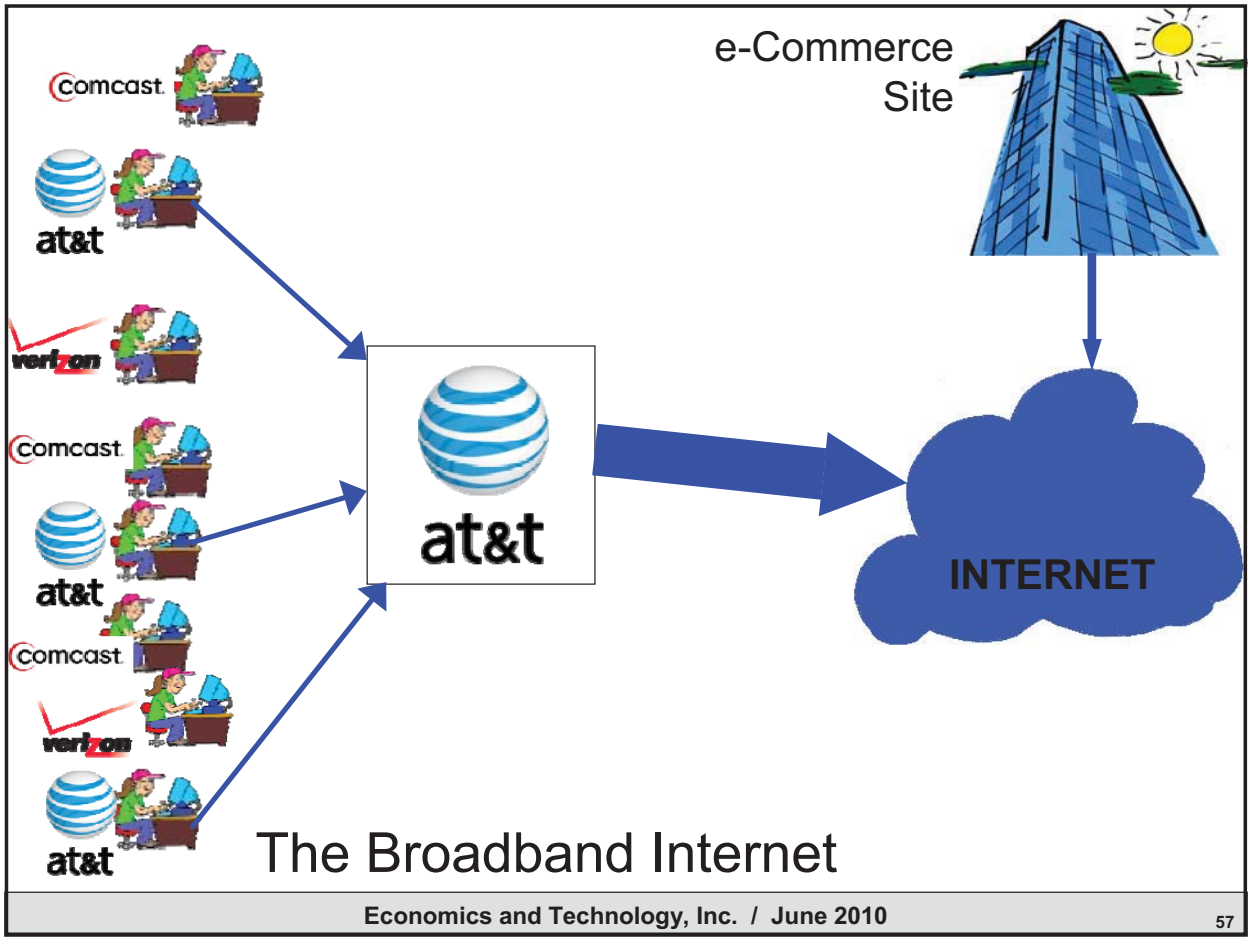
- Broadband Internet access providers are not required to unbundle telecom link from "Internet access"
- As a result, they have the economic ability to extract monopoly rents from content providers as a condition for gaining access to its end user "eyeballs"
- Unless regulators act to prevent this.

Broadband access provider can extract monopoly rents from host websites



The enduring bottleneck

- Broadband Internet access providers also have the economic ability to force host websites / content providers to use that access provider's own backbone as a condition for gaining access to its end user "eyeballs"
- Unless regulators act to prevent this.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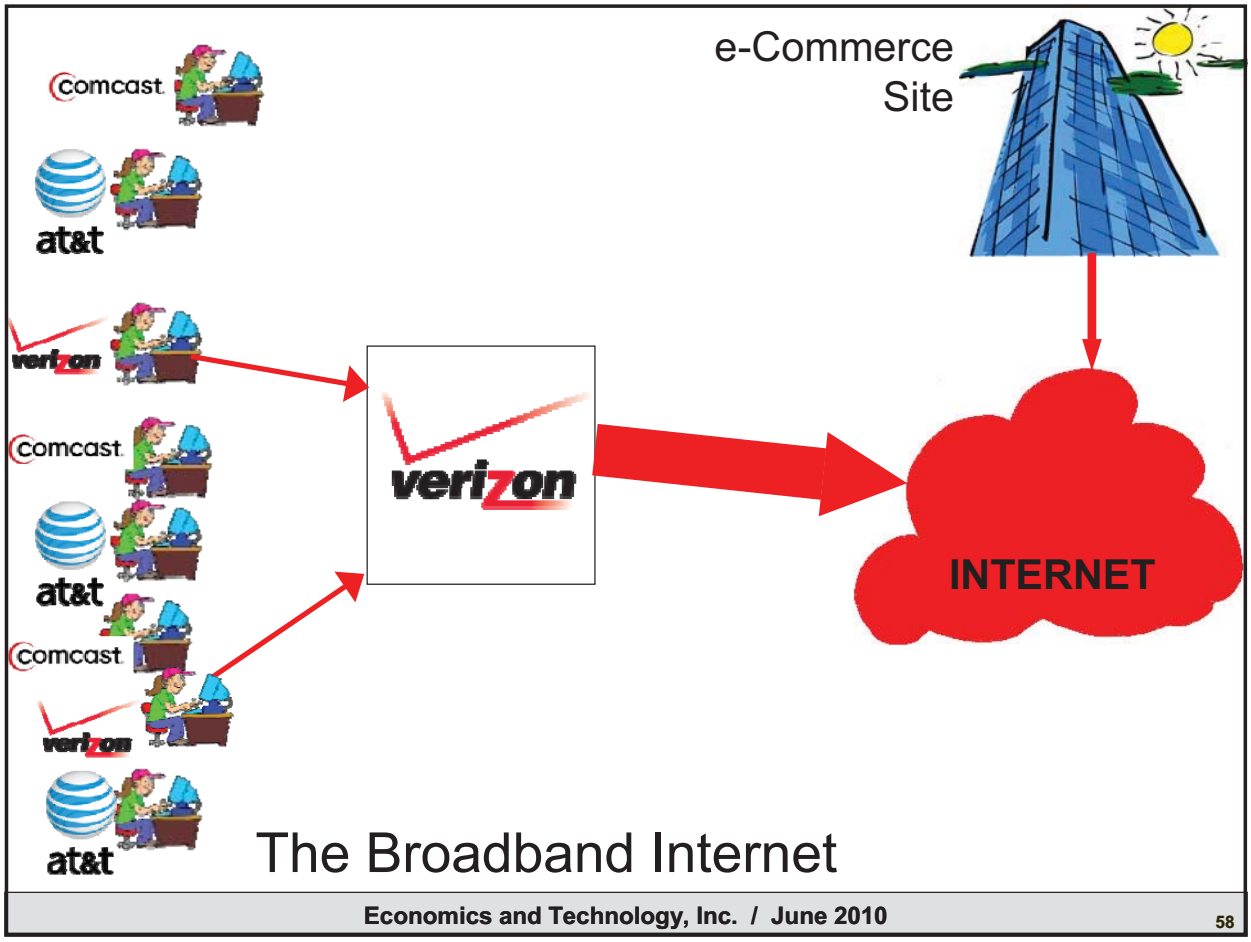
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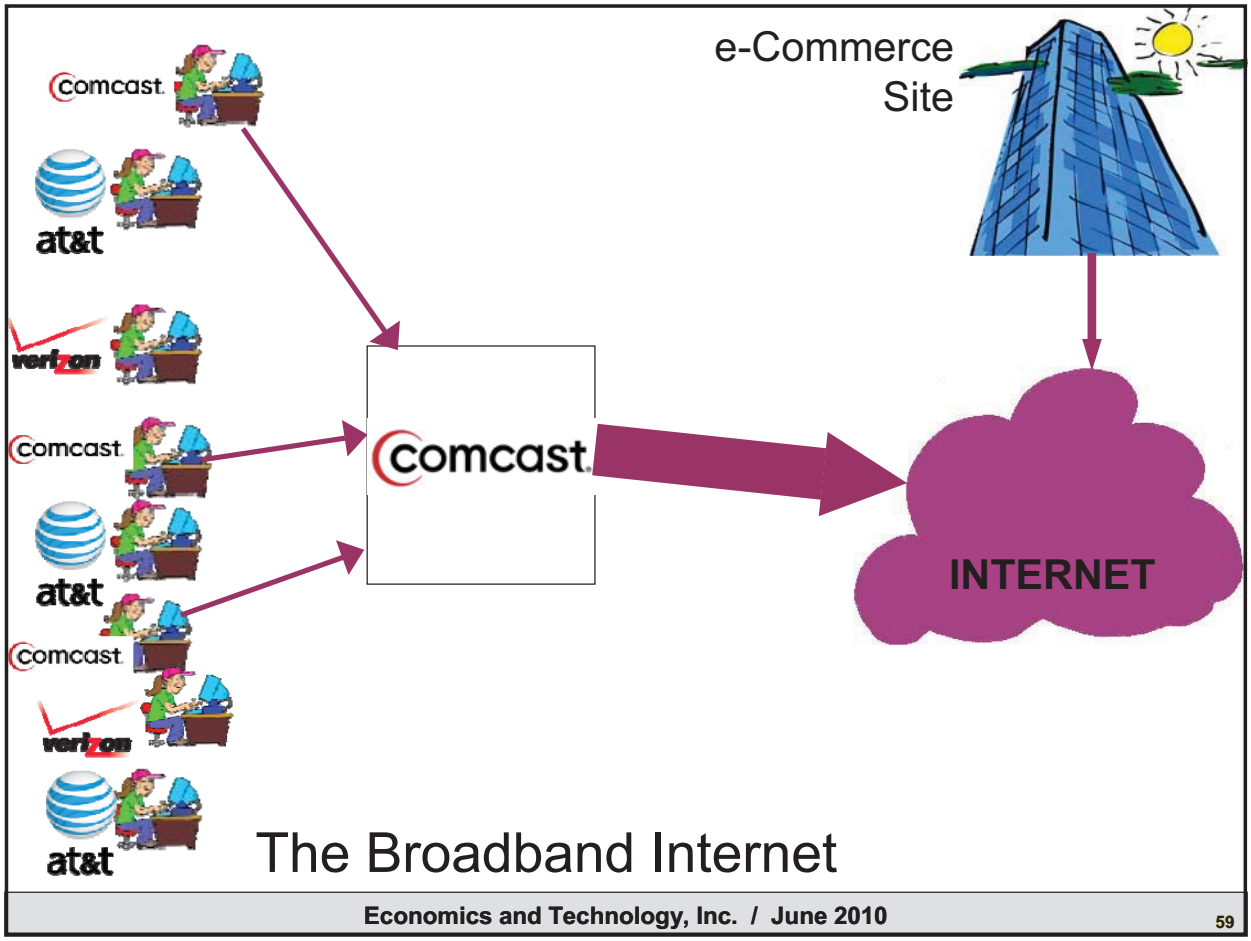
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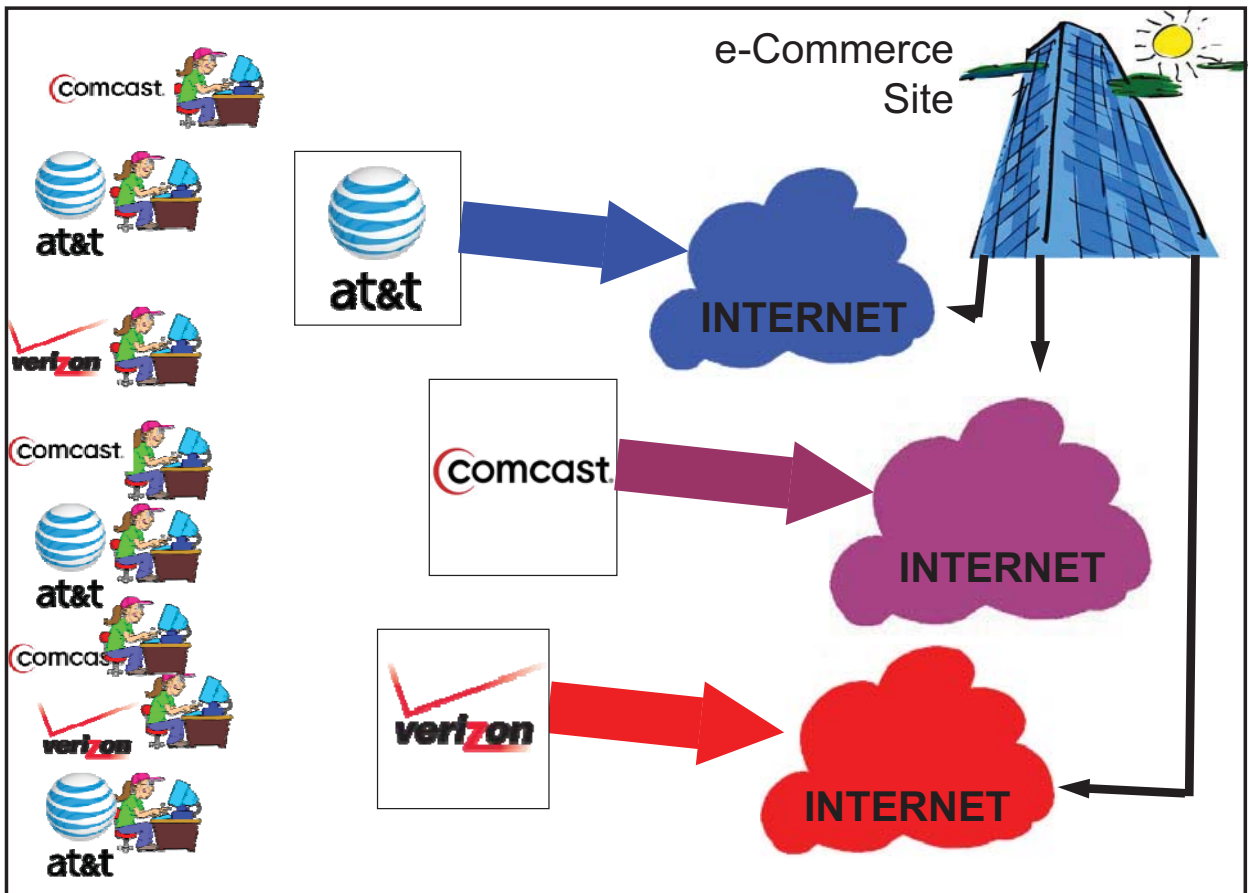
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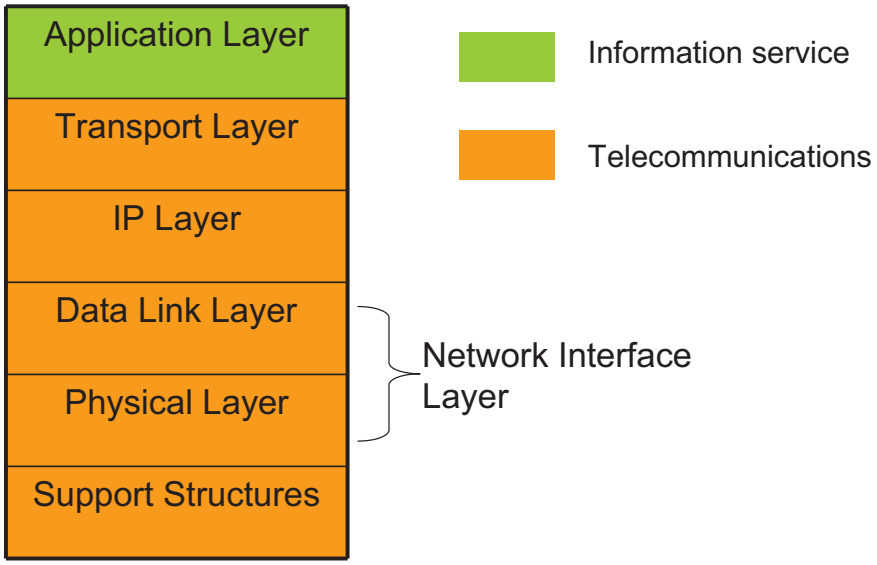
Breaking the bottleneck

- Minimize opportunities for leveraging market power
  - Reclassify broadband Internet access to Title II
  - Impose mandatory unbundling of the telecom component
- Will result in increased competition at the retail level
- Increased competition may be best way to ensure net neutrality

The correct classification



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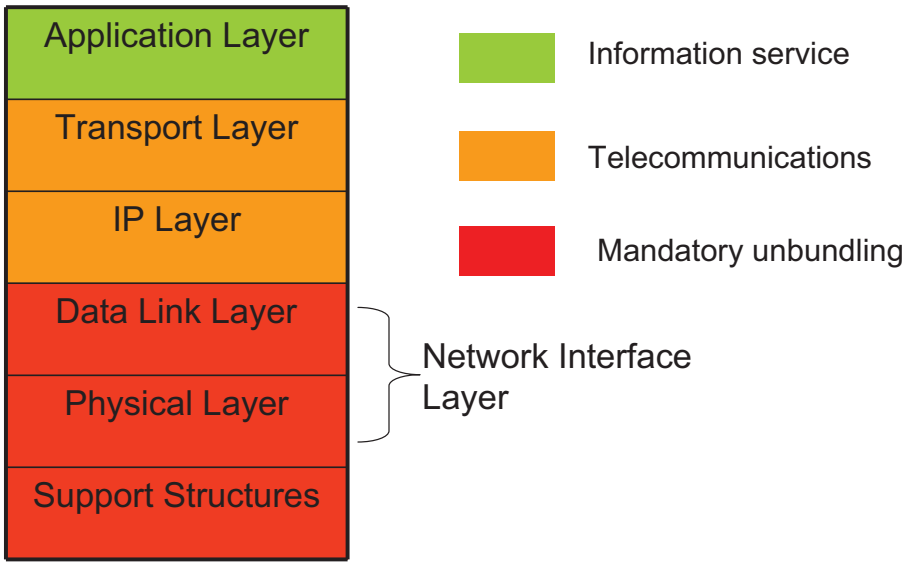

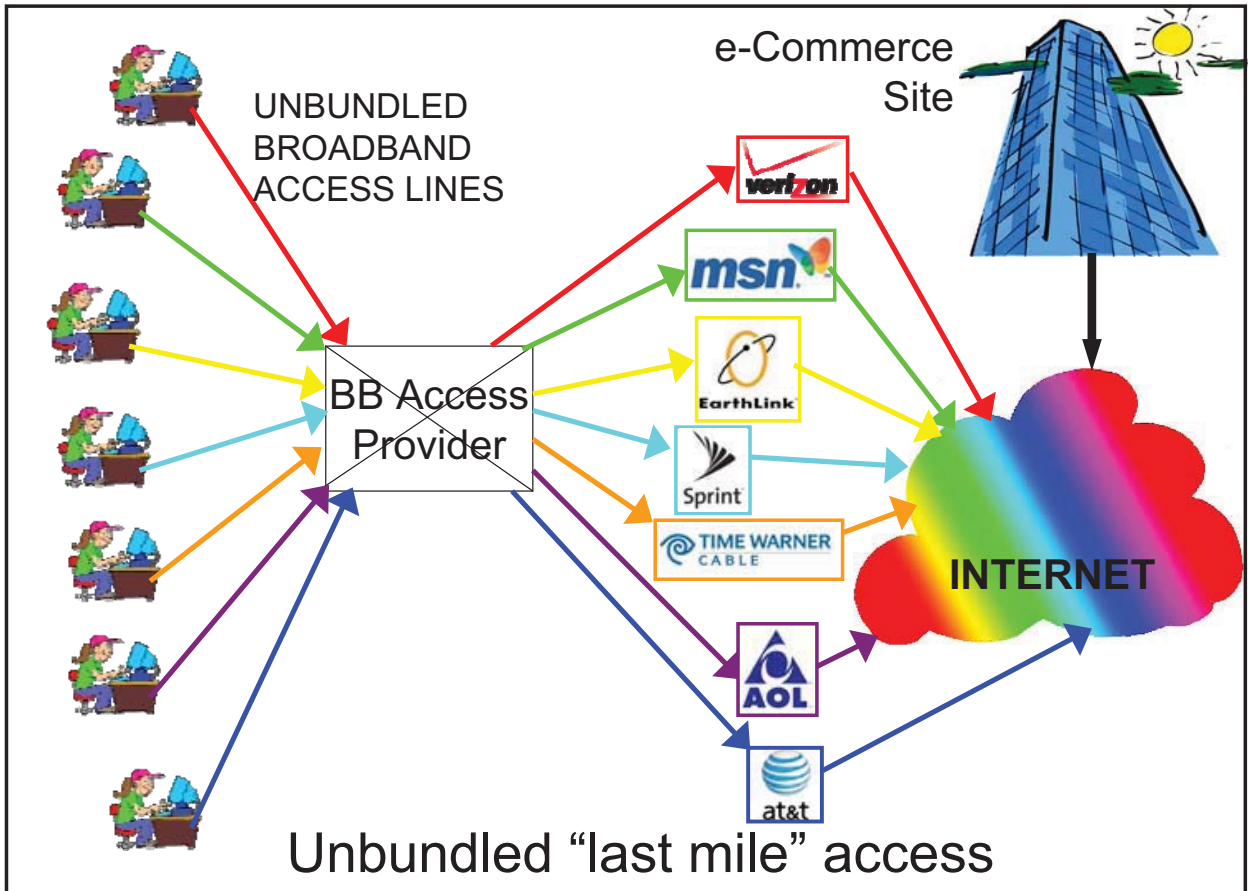

A new regulatory model

- We certainly don't want to revert to pre-1984 cost-plus rate-of-return regulation
- But we should reinvigorate the TA96 paradigm:
  - Confine regulation to only those network components where economic barriers to entry remain high
  - Assure nondiscriminatory access, at cost-based prices, to all monopoly network elements
  - Participation by incumbents in competitive downstream markets, if allowed, should be via separate affiliate afforded the same access to the core network as any nonaffiliated competitor
- The UK Ofcom/BT model

A new regulatory model

UK Ofcom's solution

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