

## Competition in Access Networks (Gillett)

This lecture will focus on the transition of the regulatory framework from monopoly to competition and the particular challenges it poses to access networks as services shift from telephony to broadband Internet. Discussion will focus on the effectiveness of policies for competition “within the pipe” (such as unbundling) vs. facilities-based competition among multiple pipes, in the context of current and emerging access technologies such as cable, DSL, all fibre networks, broadband wireless, and power lines.

## 1 Four-I's Model of Communications Policy (Gillett)

- **Ideals:** What are the goals of the policy? (Social, economic, political, technical)
- **Implementations:** What statutes, frameworks, regulations, court rulings, and administrative bodies have been put into place in the name of achieving those goals?
- **Interested parties:** Who are the stakeholders with interests in the policy outcomes?
- **Innovations:** How does the emergence of new technologies affect existing Implementations and Interested parties?

## 2 What is Broadband?

- “Broadband” refers to the transition of access networks from vertical “silos” specific to a single service (e.g. PSTN for voice) to horizontally layered “platforms” (slides from Clark, 1999)
  - Multiple physical networks (e.g. DSL, cable, wireless) each potentially supporting multiple services (e.g. data, voice, video)
- Services
  - “Data” typically includes “high-speed,” always-on Internet access
  - Voice and video may be supported in legacy and/or digital form
    - E.g. circuit-switched “cable telephony” vs. packet-switched “VoIP over cable”
  - Innovation (finally) starting to appear here
    - E.g. payment models (e.g. Internet pay per use in Italy), streaming audio (e.g. Rhapsody), IP TV, video on demand
  - Holy grail for service providers is the multi-service bundle
    - Capture multiple revenue streams to recover high fixed costs of access network

### 3 *Ideals: Broadband Challenges*

- Competition
  - Unfavorable access network economics challenge transition away from regulated monopoly.
  - Access as the “tail that wags the dog” for network competition.
  - Static vs. dynamic (sustainability)
- Discussion
  - What other ideals may be affected by imperfect access network competition?
  - Why might these ideals pose a dilemma for broadband policy?

### 4 *Implementations: Policy remedies*

- Three basic approaches in TA’96
  - Remove barriers to facilities-based competition
  - Require leasing of incumbent telephone network elements (“unbundling”)
  - Pure resale
    - “Retail minus” pricing
    - Enables multiple retail providers, but how interesting if single wholesaler?
- In context of long-standing “silo” regulations and markets that didn’t exactly disappear
  - Fixed-line telephony
    - Retail price regulation (see Woroch chapter for more details); implicit subsidies challenged by more competitive environment (e.g. mobile phones, cable telephony) and unbundling rules (below).
    - U.S.: Title II common carriage legacy and associated obligations from Computer II and III inquiries (ONA=Open Network Architecture, CEI=Comparably Efficient Interconnect)
      - CI’s “Basic” vs. “enhanced” services maps roughly into TA’96 “telecommunications” vs. “information” services
      - Codifying such distinctions into law made them less flexible
    - Competition from wireless (slide)
  - Cable TV (U.S.)
    - Regulatory flip-flops on retail price regulation; mainly unregulated since 1999.
    - Title VI: No common carrier obligations.
    - Locally franchised (usually monopoly). Should data service revenues be subject to franchise fee obligations? Etc.

## 5 Facilities-based competition

- “Convergence” - Broadband platforms can be constructed from multiple technologies and architectures, both wired and wireless
  - E.g. cable vs. DSL. Present in most urban areas of U.S. and Canada, plus some European countries with strong cable history (esp. Benelux; OECD slide).
- Extent of substitution?<sup>1</sup>
  - Performance depends on architecture, technology, and (shared) backhaul provisioning. Limits are generally not “hard” but depend on how much provider wants to invest in increased performance. (CSTB slides)
    - **DSL**: Digital Subscriber Line; telco copper network; ~0.5-10 Mbps depending on copper loop length
    - **HFC**: Hybrid Fiber Coax; cable TV network; ~1-10 Mbps depending on coax cell size (bandwidth shared among 20 - 2000 homes)
    - **FTTB/C/H/P**: Fiber to the Building/Curb/Kerb/Home/Premises; ~10-100 Mbps depending on architecture (PON vs. active star)
    - **BPL**: Broadband over Power Lines; electric utilities; ~1 Mbps depending on architecture
    - **Satellite**: ~1 Mbps shared nationwide; typically rural solution
    - **3G Wireless**: ~1 Mbps
    - **WiFi**: 802.11 wireless LAN with unlicensed spectrum; ~10-50 Mbps; typically last “100 feet” from wired connection, less common as “mesh” architecture
    - **WiMax**: 802.16 wireless MAN; ~1-70 Mbps; licensed and unlicensed spectrum bands; proposed for new wireless entrants (e.g. McCaw’s Clearwire)

## 6 Critiques of Facilities-Based Competition

- Technological possibilities vs. economic realities
  - Technologies only get deployed as part of workable business models (more below)
    - Incumbents vs. entrants (note entrant may be incumbent in other industry, e.g. BPL)
  - Duopoly in U.S. “Third pipes” have largely not materialized. Why BPL and WiMax attract so much attention from policy makers. But are these technologies more likely to “fill in” unserved areas than compete in areas already well served?
- Depends critically on related regulatory reforms

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<sup>1</sup> In economics, products are called substitutes if their cross-price elasticity has a positive sign, i.e. products A and B are considered substitutes if an increase in the price of product A is associated with an increase in the quantity demanded of product B.

- Restrictions on cross-ownership (e.g. Germany's poor broadband performance in light of history of joint ownership of telco and cable)
- Requirements for interconnection and collocation (e.g. New Zealand experience)
- Directory listings, phone number portability, etc. (esp. telephony, VoIP)
- Spectrum liberalization (esp. unlicensed and other wireless broadband)
- Not a fair fight: Unlevel playing field for facilities competition
  - Restrictions on unconventional facilities providers, e.g. municipalities and community groups
    - *Nixon vs. Missouri Municipal League* case decided by U.S. Supreme Court March 2004 (argued based on Section 253(a) of TA96, "Any entity") – leaves municipal networking at the discretion of each state
    - European use of structural funds for public investment in communications infrastructure (requires wholesale-only network)
  - Incumbent access providers enjoy advantages based in history, such as:
    - Implicit franchises, access to rights of way and utility poles
    - User base (customer information)
    - Brand name
    - Regulatory capture
  - Incumbent networks would be more costly than entrants if re-built from scratch...but not starting from scratch.
    - Incremental investment is what matters, and this is typically less costly for incumbents.
- Access network economics suggest limits to sustainable competitive intensity
  - Dominance of fixed costs leads to increasing returns to scale ("natural monopoly" relative to expected demand).
    - High fixed costs (FC), low marginal costs (MC) lead to economies of scale: Lower cost per subscriber when costs spread over larger customer base (i.e. cost curve always declines with volume).
      - Installation costs (labor, construction, tower siting, etc.) are significant component of overall cost, and not on a Moore's Law curve.
      - Switching/routing etc. equipment generally engineered and priced with scale economies. (Might this change?)
    - Implications for sustainability of competition: tipping?
  - And, especially for wired networks:
    - Access costs are largely sunk. Not easy to redeploy the assets if customer drops service.
    - Often involve public disruption – digging streets, access to utility poles, etc.
    - These are characteristics that led in the past to "natural monopoly" treatment, with single franchised provider of telephone or cable TV service.

- Another way of looking at access economics: “Tyranny of the Take Rate” (CSTB)
  - When most (e.g. construction) costs incurred per home passed, rather than per subscriber:

Penetration rate	5%	10%	50%	100%
Cost per Subscriber	\$20,000	\$10,000	\$2,000	\$1,000

- Artifact of incumbent thinking? For incumbents with high penetration (mature services) and market share, “optimal” technology designed to exploit economies of scale.
- Entrant strategies (new services and/or small market shares) better supported by technology with lower up-front costs and ability to scale up with more investment as (or if) demand materializes.
  - E.g. cable modem; wireless “cell-splitting;” Sirbu and Banerjee “OFAP” proposal (fill/add PON splitters as customers emerge)
  - Related strategy: Shifting of cost to end users whenever possible.
    - E.g. self-purchase/install cable and DSL modems.
    - May be particularly important for FTTH, where customer boxes are still significant fraction of cost, especially when useful lives of different components are factored in.
- Extent of facilities competition will clearly vary by geography
  - Economies of scale mean it’s less costly to serve higher density areas.
    - Example: If a head end or central office has fixed cost to serve from 1 to 100,000 customers, then a town of only 30,000 people has 3x higher costs per subscriber for this component.
    - Higher density can also reduce the extent of the network that is dedicated to individual users, lowering the cost per user substantially. E.g. LAN access to apartment blocks in Stockholm & Seoul.
  - National Research Council CSTB classification of types 0, 1, 2, 3 communities depending on how much competition likely to attract.
    - Based mainly on density of likely subscribers, which is a function of raw population density plus other demographic factors (age, occupations etc).
  - National-scale policies vs. varying local contexts (urban vs. rural)

## 7 Local Loop Unbundling (LLU)

- What is it: Entrant leases loop (access) related elements of incumbent’s network
- Philosophy behind it: Enable entrants to provide broadband services without having to build the piece of the network that is generally considered cost-prohibitive / “natural monopoly”

- A way to get competition even if loops are “bottleneck facility” that cannot be economically duplicated
- A first step vs. an endpoint? Effectiveness of sunset clauses? (Canadian experience)
- Types of LLU (Slides)
  - Full: access to the **physical** copper pair
  - Bitstream: access on the other side of the DSLAM; a.k.a. **logical** unbundling or “shared access;” note similarities to cable “open access” via tunnelling or source-based routing
  - Sub-loop: like full, in presence of hybrid fiber-copper between central switching office and end user
  - Line sharing: access to only the non-voice **frequency** bands on the loop
- Implementation status
  - U.S.: Telecommunications Act of 1996 experimented with all 3 approaches (resale, facilities-based, unbundling)
    - TA96 crafted with telephony in mind, not Internet
    - Broadband came later; unbundling provisions (UNE = unbundled network elements) largely undone by FCC and courts
  - E.C.: Regulation 2887/2000 requires unbundled access to the local loop
    - In force January 2001; later timing leads to sharper focus on relevance for broadband
    - New (2002/3) Framework: 2 of the 18 markets to be analysed for Significant Market Power (SMP) in each national context are:
      - (11) Wholesale unbundled access (including shared access) to metallic loops and sub-loops for purposes of providing voice and broadband services
      - (12) Wholesale broadband access (‘bit-stream’ access that permit 2-way transmission of broadband data)
    - See OECD report for status in individual countries as of last year (but note, situation changing rapidly in some since that report)

## 8 Critiques of LLU

- Pricing
  - U.S.: Telecom Act mandated rates set by federal TELRIC (forward-looking cost) formula, with per-state proceedings to derive UNE costs/prices.
  - E.C.: Pricing methodology not mandated. Issue of “price squeeze” when retail loop prices below cost (i.e. geographically averaged retail prices, no “rate rebalancing” yet).
- Complexity

- Not a simple interface
- Collocation, operational/OSS issues
- Delays
- Enforcement difficult - inherent conflict of interest
  - Unbundling as an “unnatural act” for vertically integrated providers
  - Strong need for regulatory interventions, arbitrations
  - Japanese case as counterexample?
- Regulatory asymmetries
  - If unbundling is a good idea for copper, why not for other access technologies?
    - Cable “open access” debate, *Brand X* case
    - Note: copper mainly paid for under rate-of-return regulation
  - Alternatively...If it is not needed in presence of facilities-based competition, why is copper singled out? (current FCC direction)
  - How to regulate if facilities-based competition is geographically spotty?
- LLU as implemented is “backward-looking”
  - Does not address next generation, e.g. FTTH, expected to require lots of new **investment**. FCC: “new rules for new wires.” October 2004 ruling extends to FTTC as well.

## 9 Proposed alternatives

- Structural separation
  - Relevance of municipal “wholesale only” experiments (slide)
- “Logical Layer Unbundling” (CSTB)
  - Aka “open access” / bitstream access?
  - If so, same issue of QoS challenges.
- Network Neutrality (Wu, 2003)
  - Forget about separating anything, just try to prevent the undesirable behaviors.
  - Distinguish between “legitimate” and “suspect” forms of discrimination by broadband providers. “Local” restrictions OK (e.g. bandwidth), “Inter-Network” restrictions not (e.g. blocking particular applications by port number).

## 10 Revisiting the Broadband Dilemma (slide)