

Public Policy and Broadband Networks

- Internet and Broadband Networks
- Long predicted; has their day finally arrived? Is Internet the vehicle?
- What's special about two-way broadband?
 - two-way exists: telephone
 - broadband exists: TV and cable
 - but *both* two-way and broadband opens up new vast new possibilities
 - Technically feasible since early 1970s, but apparently no market for it
- Comes the Internet; is this the breakthrough?
 - Again, the Internet has been around since the late 1960s.
 - Why the fuss now?

The Strange Case of the Internet

- Why the Internet? Why now?
- *Necessary* conditions for growth:
 - Invention of the World Wide Web; a universal protocol for *easily* accessing information anywhere.
 - Invention of *easy-to-use* browsers (Mosaic, then Netscape); interface between users and the WWW.
 - 30% of US households own PCs, with either Windows or Mac (1993).
 - Sufficient information on the WWW to make it interesting to browse.
- Industry caught napping; “multimedia” craze completely unaware (or dismissive) of Internet
- Growth of Internet traffic/sites literally unparalleled in history
 - faster diffusion than phones, TV, PCs.

Is It Serious?

- 1994: the Internet as the oat bran muffin of the '90s.
- 1995: Microsoft introduces Windows 95, with a CompuServe clone (MSN) bundled.
- December, 1995: Microsoft announces “turnaround” of its Internet strategy.
 - Internet is now “real”
- 1996: the year of the Internet start-up.
 - Huge P/E multiples, high growth projected
 - Telcos get involved
- Has broadband finally arrived?
What will it look like? Who will run it? What can I buy?

Convergence

- Convergence of traditionally distinct industries, with different *public policy* traditions
- Computer hardware & software
 - technology- and market-driven
 - little government intervention
- Entertainment
 - deal-driven
 - government a way to gain advantage
- Telephone
 - operations-driven
 - heavily regulated; price, quality, entry
- Cable
 - short-term-financials-driven
 - On-again-off-again regulation
- Internet cowboys

Public Policy Issues

- Universal Service
 - Existing industries have achieved high penetration of business and personal markets
 - Will Congress demand that everyone have access to the new Internet?
 - Price: usually implies some form of subsidy from high-value/low-cost users to low-value/high-cost users. If done with internal subsidies, *requires* regulated monopoly!
 - Internet stamps an option, but politically unlikely
 - Would competition achieve the universal service objective?
- Quality of Service
 - The “World Wide Wait;” service is poor. Is regulation the answer?
 - re: cable re-regulation

Public Policy Issues

- Natural Monopoly
 - Are network businesses necessarily monopolistic?
 - Telephone, cable appear to support this
 - If true, then regulation may be the only answer to monopoly abuse (re: cable re-regulation)
 - But perhaps regulation is the problem; the industry becomes monopolized *because* of regulation. Cable, telephone
- Vertical Integration (content vs. conduit)
 - If a single firm controls the conduit to the business/home, should they control the content as well?
 - telephone: common carrier model
 - cable: conduit controls content
 - 1970s computer industry model

Universal Service

- Political demand for universal service quiescent
 - Gingrich: a notebook for every ghetto kid
 - Gore: high-speed connections a must for jobs in the 21st century
- Telecommunications Act of 1996 focuses on providing (subsidized) broadband to schools and libraries
 - If this is “universal service,” then no problem
- If a political demand for universal service, then regulated monopoly a likely outcome, at substantial cost
 - low rate of innovation; slow diffusion
 - already exists ubiquitous access: 28.8 Kbps; what’s the *additional* value of broadband?

Quality of Service

- The incredible growth of the Internet has placed demands on the network it has not been able to meet.
 - Substantial slow-down of network response
 - Transoceanic a problem
 - “real-time” applications (telnet, video) suffer the worst degradation
 - But the predicted collapse hasn’t happened
 - Investment has not kept pace with demand.
- Is public intervention the solution?
 - Overhaul the Internet governance structure
 - Pricing and revenue sharing; get the incentives right
 - Develop and integrate new networks

Monopoly and Vertical Integration

- At the end of the day, maybe only the telecoms will lay fiber to the home
 - New technologies may not find investors; cable companies hold too much debt; etc., etc.
- So is monopoly bad?
 - If there is only room for one player, then monopoly pricing will probably not be ruinous
 - BUT will the monopoly conduit provider end up monopolizing content (IBM, *circa* 1970)
 - Solutions:
 - Telco Act of 1996 provides local firms to permit access to conduit facilities at wholesale prices
 - Open Video Systems; same for broadband video

Monopoly vs. Competition

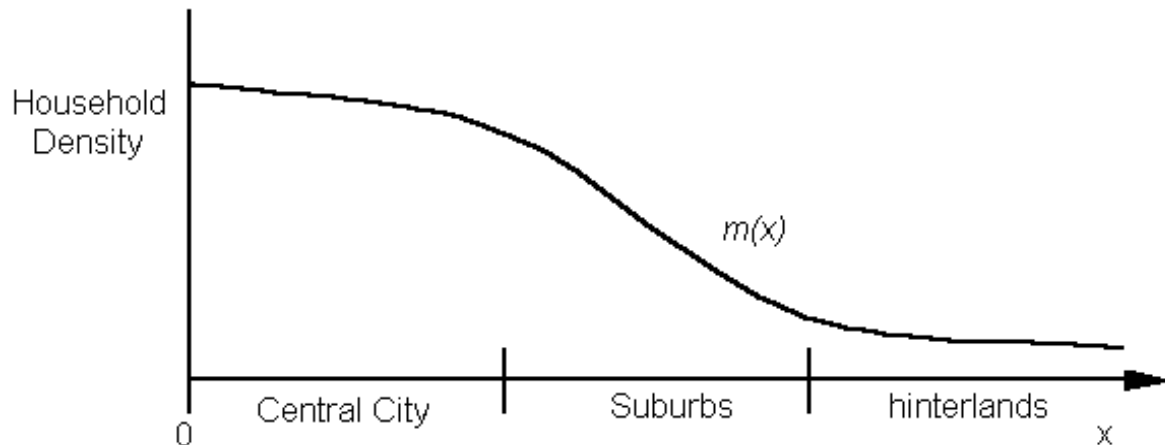
- But is monopoly the necessary outcome? History tells us “yes;” virtually all networked industries are regulated monopolies!
- In today’s competitive climate, Congress appears to be warming to market forces.
- If regulators were held at bay, what would a “competitive” market look like in broadband?
 - Oligopolistic
 - Intermodal; fiber may compete against DBS satellite, ADSL, and/or cable modems
- Using current engineering estimates of costs, at what demand levels would we see competitive supply?

Technology of Broadband Networks

- Cost Structure
 - cost per unit of usage (e.g., per minute)
 - cost per user (per person, per HH)
 - cost per potential user (per “homes passed”)
- “Geographic” networks
 - fiber, hybrid fiber/coax.
 - physical lines must be placed near homes and businesses of potential users
- “Non-geographic” networks
 - satellite, ADSL (depends on universal telecom network)
 - “instant” coverage of all potential users
- Demand Structure
 - functionality differs among systems
 - bandwidth in, bandwidth out
 - great uncertainty

Model of Competition

- Market Geography:



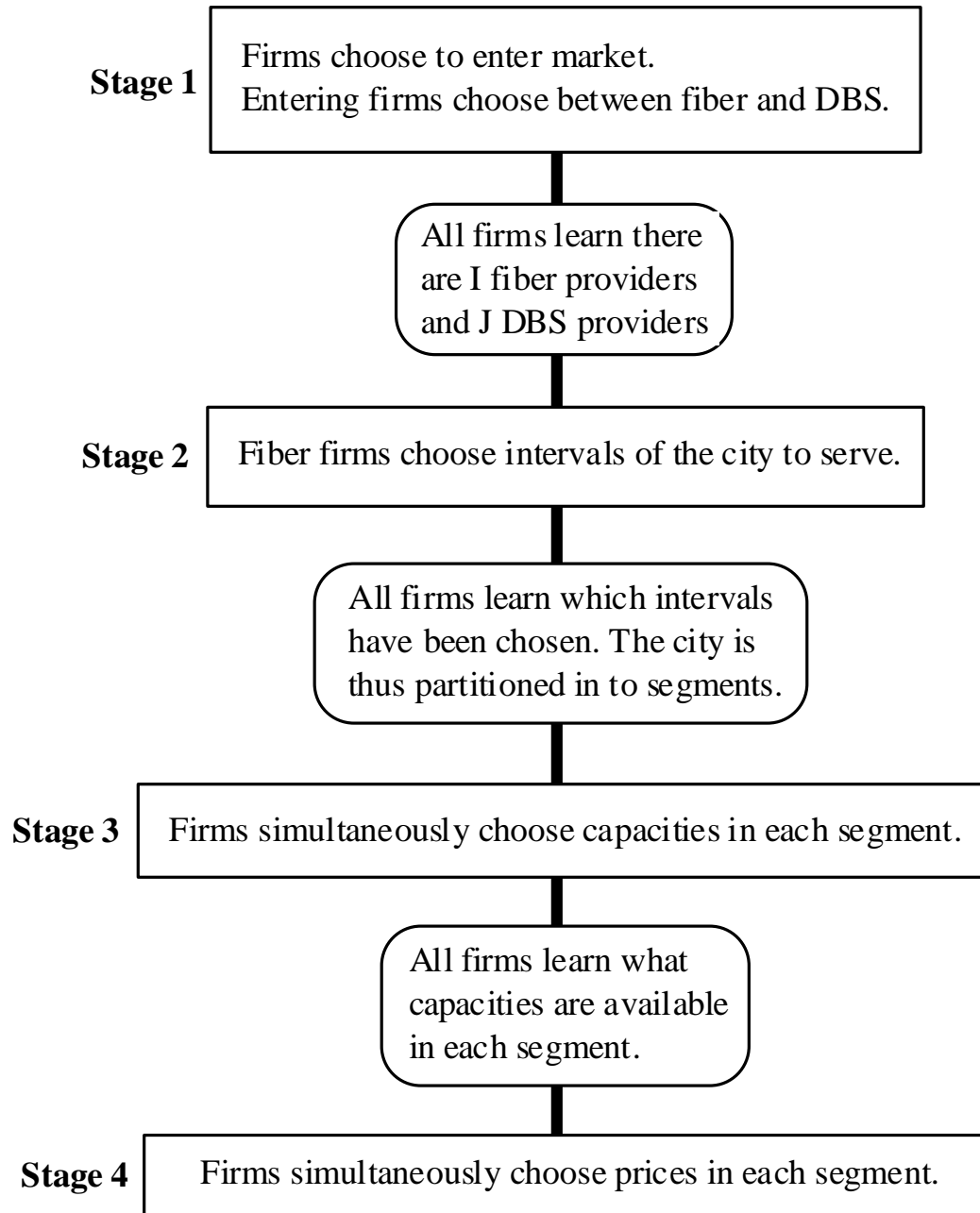
- Firm Decisions:

- technology to use: fiber or DBS
- what sections of the linear city to lay fiber (intervals $[h_1, H_1]$, $[h_2, H_2], \dots$)
- how much capacity to install in each segment
- what price to charge

- Demand:

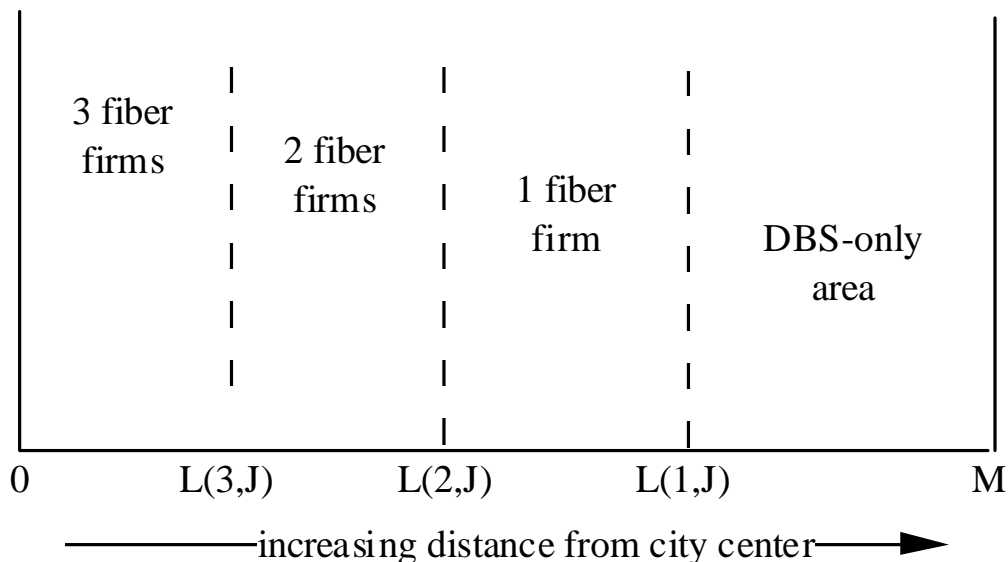
- heterogeneous goods
- percentage of households
- price = fixed fee (a la Internet today)

The Game



Equilibrium

- Stage 4: Bertrand in each segment
- Stage 3: Choose capacity in each segment
⇒ Result is Cournot (Kreps-Scheinkman)
- Stage 2: Fiber firms select what segments to serve (asymmetric equilibrium):



- Stage 1: entry ⇒ negative profits

What is the Question?

- If free competition is permitted, what will be the outcome?
 - number of firms (fiber and DBS)
 - prices (fiber and DBS)
 - fraction of households which take service
 - fraction of households with service available
 - farthest reach of fiber systems
- How does this outcome depend upon the realized demand?
- Does this achieve “universal service”? Are the goals of public policy served?

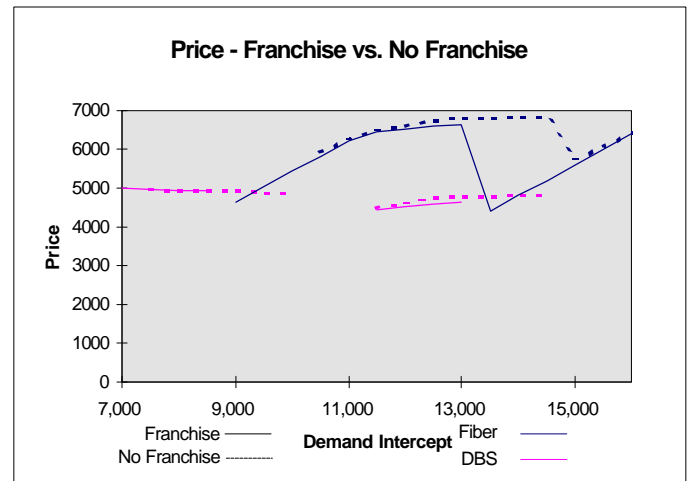
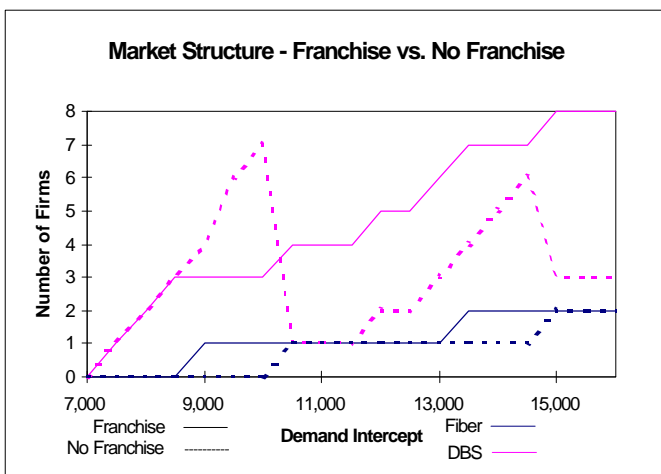
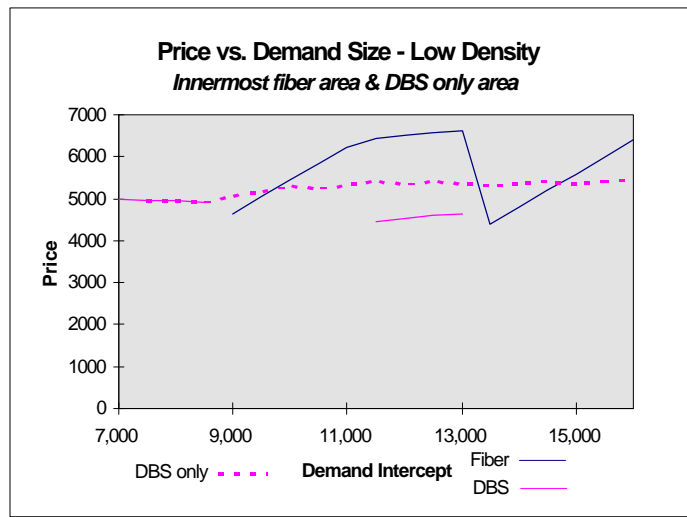
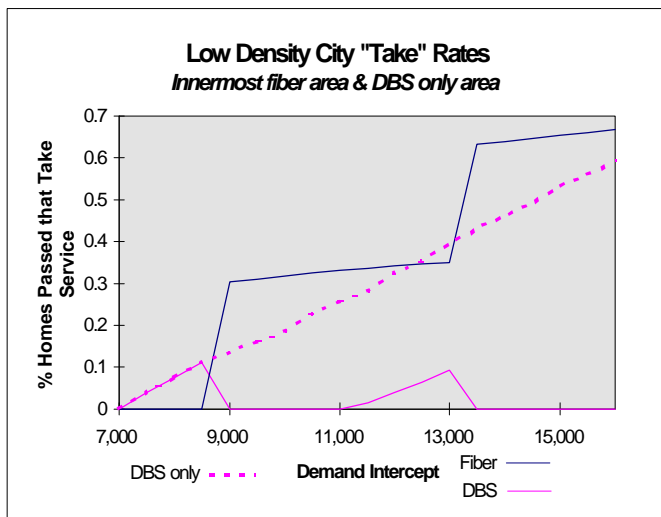
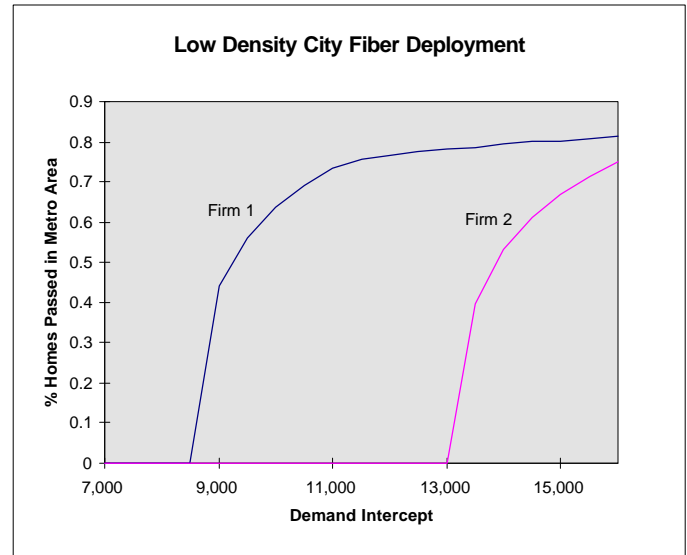
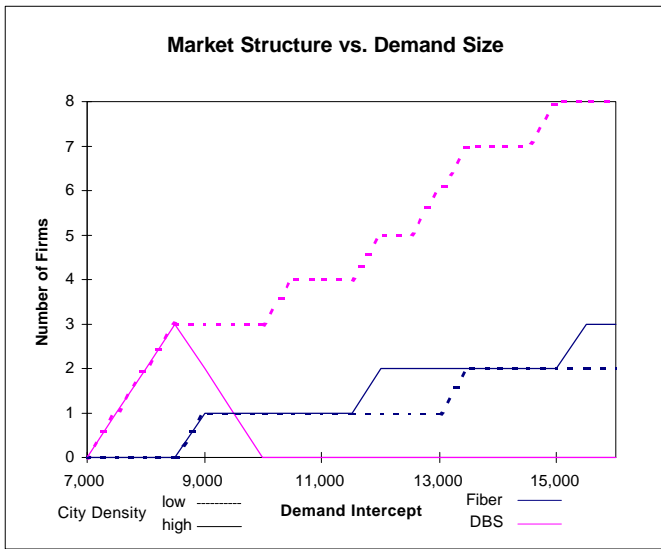
Franchising

- Universal service: is competition “good enough”?
- One policy option to ensure universal service: require that any entering firm serve (say) 95% of its metro area as a condition of franchise.
- Easy for DBS, difficult for fiber.
- What does this franchise requirement do to the equilibrium?

Sensitivity Analysis

- Available data: engineering estimates of cost, virtually nothing on demand
- Assume linear demand functions for fiber and DBS
- Fiber fixed costs ($=\$15\text{ M}$)
- Satellite fixed costs ($=\$15\text{M} + \25M transponder cost)
- Fiber network costs:
 - requires population density function; we parameterize with $\theta = \%$ of city population $> 400/\text{sq mile}$
- Fiber & satellite per subscriber capacity cost ($= \text{ISP costs} = \$20/\text{mo}$)
- Vary demand function intercept for fiber and satellite, and θ .

Simulation Results



Model Conclusions

- Fiber deployment awaits an increase in demand, but not by much
- For dense cities, two or even three fiber firms can coexist at “take” rates similar to cable TV
- Satellite a niche technology for dense cities, but important for sparse cities
- For dense cities, the franchise requirement makes little difference; for sparse cities, reduces competition and raises prices.
- With continued interest in Internet, we can expect monopoly fiber rollout soon, duopoly somewhat later; DBS helpful
- Regulation not such a good idea; franchise requirement not awful.