

Internet Economics

Yesterday

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- Single backbone (more or less)
- Regional networks: BARRNET, Merit, etc.
- Funding: NSF subsidy + user fees
- Traditional applications
 - ftp (45%)
 - email (15%)
 - remote login (10%)
- Exponential growth: traffic doubled every year 1990-95

Today

Outline

- Privatized as of April 30, 1995
- Several T3 backbones
 - telcos: MCI, Sprint, ATT
 - leased lines: ANS, PSI, UUNET
- NAPs and other interconnection points
- Several regionals privatized
- Many independent service providers
- Self-supporting (in principle)
- New applications: Web, voice, video, Java
- Increased rate of growth (doubles every 6-9 months)

Problems facing key players

- LECs
- ISPs
- Broadband to home (phone and/or cable)
- Backbone providers
- Interconnection
- Quality of service
- Multicast
- Accounting and billing

Congestion at LEC

- Pacific Telesis
 - average voice call 3.8 minutes
 - average Internet connection 20.8 minutes
 - 10% of Internet calls 6 hours or more
 - peak hour 10 PM at POP
- Economic problem for flat rate local calling
- Do we want more investment in local POTS capacity?
- FCC: Enhanced Service Provider: no access charges
- 4 POTS lines = 1 ISDN
- Regulatory environment very uncertain

Data-friendly networks

- Get packets off the circuit-switched network
 - Data splitter, non-blocking switches
 - Aggregate traffic at local switch
- Issues
 - Who owns local router?
 - Opportunities for caching
 - Demographic card
 - Coordination with rest of network

Indep. Service Providers

Cost structure

- equipment (10%), line rental (30%)
 - operations (30%)
 - sales, marketing, administration (30%)
 - human resources are more than 50% of expenses
- ## competition from LECs
- currently capture 30% of end-user ISP revenue
 - high labor + operations costs for RBOCs
 - costs \$750 to install ISDN
 - (even more if more than 18,000 feet from switch)

Broadband to home

- Cable modems
 - quality of network; amplification; upstream noise
 - asymmetric and shared bandwidth
 - local maintenance costs?
- ADSL
 - installation costs are high; interference with POTS
 - access: only 60-70% of homes can use
 - connection-oriented system

Backbone meltdown

- Meltdown if either cable modems or ADSL catches on, backbone
- Problem of commons/shared resource
- Parts of solution
 - pricing
 - cacheing
 - multicast

Backbone provider

- Cost advantage to owning fiber (MC=10% of price)
 - Economies of scale on QoS
 - if difficult to manage QoS with interconnection...
 - then biggest firm has biggest advantage
 - 800-numbers = 1/2 of all long distance calls
 - Possible industry structure
 - 2-3 backbone providers
 - lots of "ISPs" for small customers; direct connect for big customers
- How much customer support will be necessary?

Interconnection

- Business model for interconnection
- sharing fixed costs, e.g. routing tables
 - usage sensitive costs, e.g., quality
 - metrics; i.e., how to measure performance
 - accountability; e.g., who to blame
 - settlement; based on what?
- Incentives to interconnect are weird
- bilateral interconnection is not too bad
 - multi-party interconnection has problems

Example: three networks

- Suppose 2 independent network interconnect and third network arrives
 - Who has bargaining power?
- Two incumbent networks each provide same connectivity
 - make them compete against each other
- Example of CIX
 - paid \$10,000 yearly fee to connect to CIX
 - some members sold access downstream
 - CIX threatened to filter traffic

Quality of service

- Real time applications
video, voice
- How to handle?
separate network?
RSVP?
priority classes?
- Incentives
how to get people to choose appropriate quality?
prices likely to be part of solution
consequences of application-blind nature of IP

Multicast/cacheing

- Idea of multicast
same content goes down given line once
mostly used for real-time broadcasts
- Would be very nice for Web
cacheing: regional or local
incentives to cache; AOL
- @home model
Internet dialtone
premium cacheing service

Accounting and billing

- Two models
phone company
post office
- Distributed accounting
micropayments
smart cards
- Basic service flat rate or step function
- High QoS: pay as you use

Summary

- Paradox of Internet history
 - public subsidy eliminated need for business models
 - subsidy needed to achieve critical mass
- Development of business models
 - ease of use; customer support
 - interconnection
 - quality of service
 - efficient use of network
 - accounting and billing