Internet economics

- 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

Yesterday

- 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)
- Multicast
- Quality of service
- Interconnection
- Backbone providers
- Broadband to home (phone and/or cable)
- ISPs
- TLECs
- Problems facing key players

Outline

- LEcs
- ISPs
- ISPs
- TLECs
- Multicast
- Quality of service
- Interconnection
- Backbone providers
- Broadband to home (phone and/or cable)
- Increased rate of growth (doubles every 6-9 months)
- Self-supporting (in principle)
- New applications: Web, voice, video, Java

Today

- Privatized 6-9 months
- Increased rate of growth (doubles every 6-9 months)
- 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
- ISPs
- TLECs
- Multicast
- Quality of service
- Interconnection
- Backbone providers
- Broadband to home (phone and/or cable)
- Increased rate of growth (doubles every 6-9 months)
- Self-supporting (in principle)
- New applications: Web, voice, video, Java

Internet Economics
• 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

• Get packets off the circuit-switched network
  Data splitter, non-blocking switches
  Aggregate traffic at local switch

• Issues
  Demographics of bandwidth
  Opportunities for caching
  Who owns local router?
  Aggressive rate at local switch
  Data splitter, non-blocking switches
  Get packets off the circuit-switched network

• Competition: local router
  Human resources are more than 50% of expenses
  Sales, marketing, administration (30%)
  Operations (30%)
  Equipment (10%), Line rental (30%)

• Cable modem
  cost $750 to install ISDN
  installation costs are higher than POTS
  quality of network, amplification, upstream noise
  cost structure

• Broadband to home

• Data-friendly networks

• Independent Service Providers

• Broadband

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

Meltdown if either cable modems or ADSL catches on, backbone

Problem of commons/shared resource

Parts of solution

Pricing

Multicast

Grid

Backbone

Interconnection

Example: three networks

How much customer support will be necessary?

Cost advantage to owning either (MC=10% of price)

Economies of scale on QoS

When biggest firm has biggest advantage

Possibility of 1/2 of all long distance calls

Jobs of “ISPs” for small customers, direct connect for big customers

Sharing fixed costs, e.g. routing tables

Sharing fixed costs, e.g. routing tables

Usage sensitive costs, e.g., quality

Measurable, e.g., how to measure performance

Accountability, e.g., who to blame

Settlement, based on what?

Bilateral interconnection is not too bad

Multi-party interconnection has problems

Revenue sharing doesn’t work

Backbone meltdown

Example of CIX

Two incumbent networks each provide same connectivity

Who has bargaining power?

Supplier of independent network interconnect and third

Suppose 2 independent network interconnect and third

Example of CIX

paid $10,000 yearly fee to connect to CIX

make them compete against each other

Incentives to interconnect are weird

Settlement of “Settlement”

Others

How to measure performance

Accountability, e.g., who to blame

Usage costs, e.g., quality

Metrics, e.g., how to measure performance

Settlement, based on what?

Bilateral interconnection is not too bad

Multi-party interconnection has problems

Incentives to interconnect are weird

Notes
• 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

Quality of service

Internet dialtone
premium caching service
Internet dial-tone
@home model
  incentives to cache: AOL
  incentives to cache: regional or local
Would be very nice for Web
mostly used for real-time broadcasts
same content goes down five times once
Idea of multicast

Multicast/caching

Idea of multicast