Economic Issues Facing Internet

Hal R. Varian
SIMS, UC Berkeley
http://www.sims.berkeley.edu/~hal

Interconnection

- Bilateral interconnection
  - common
- Multilateral interconnection
  - uncommon
  - highly congested at 5 original NAPs
  - few new NAPs
- Why?

Metcalfe’s Law

- Value of network to user = kn
- Total value of network = kn^2
- Large network connects to small one
  - big network: lots of users get a little extra value
  - small network: a few users get a lot of extra value
- Value of interconnect is the same!

Multi-party Interconnect

- Commercial Internet Exchange (CIX)
- Each paid $10,000/year for settlement-free peering
- Problem: not stable to competition
  - history of CIX
  - once connected, you create your own competition

Conclusion on Interconnect

- Bilateral interconnect may get by without settlement
- Multilateral interconnect can’t
- Will need settlements to support multi player interconnect
- Want: fair, reasonable, non-discriminatory terms
Quality of Service

- IP = no quality bits (best effort)
- Applications and users need different qualities
- Questions for ISPs
  - How much does it cost to provide different QoS?
  - How much will people pay for QoS?

Cost and Revenue

- **Cost** is an engineering question
- **Revenue** is an economic question
  - INDEX: www.index.berkeley.edu
  - Give 150 Berkeley people ISDN
  - Simulate service quality differentials
    - bandwidth, congestion, delay to connect
  - Make them pay for quality bits

Demand for 128 KBS

- [www.index.berkeley.edu](http://www.index.berkeley.edu)

Quality of Service

- No good ways to contract on QoS at interconnect
- Must specify: quality, measurement, accounting, paying for QoS
- Result: QoS disappears at administrative boundaries
- Aggravated by bill-and-keep

Impact on Market Structure

- Standard for QoS: quality could be maintained across admin domains
- No standard for QoS: quality can only be maintained within admin domain
- Hence: bigger firms can provide higher quality to more places
- Without QoS standards, tendency towards monopoly
Role of Standards

- With standards: competition *within* a market
- Without standards: competition *for* a market
- Conclusion: want standards for QoS
  - to provide better services to consumers
  - to maintain competitive market for ISPs

Residential Broadband

- Cable modems
- ADSL
  - ILECs
    - who integrates with rest of network?
  - CLECs
    - who pays for conditioning?
- Backbone meltdown