The Business Case for Internet Pricing and Benefits to Network Security

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Internet Infrastructure Business Model

Backbone provider B

Customer A

Customer C

Bilateral Service Level Agreements (SLAs)
Business Model Problems

- Incomplete Contracts
  - SLAs are inherently incomplete
  - Transaction costs are high
  - There is room for opportunism

- Externalities
  - Agreements between A and B affect C’s value
Implications for Network Security

- Incentives for SLA enforcement is often weak
- SLAs may not prevent new security problems
- Externalities include network security risks
Traditional Economic Solutions May Cause More Harm than Good

- Regulation
  - Concerns about centralized Internet governance

- Vertical Integration
  - Already a fairly concentrated market: Herfindahl-Hirshman Index (HHI) is approximately 2500
  - Monopoly -> competition -> oligopoly/duopoly (Alan Pearce)
ISP Technology Adoption

For the ISDN model: \( F = 26.621 \), adjusted \( r^2 = 0.008 \), observations = 5,996

For the DSL model: \( F = 54.692 \), adjusted \( r^2 = 0.018 \), observations = 5,996
Internet Pricing Framework

Ex-Post Charging

Accountability

Implementatio

Network Management

Quality of Service

Extensibility

Scalability

Security

Network externality

Accountability

Implementatio

Network Management

...
Effective Bandwidth

\[ P_{\text{expost}} = a \ast (C + \Delta B) \]

\[ C = \frac{\alpha b (1 - \rho) R_p - B + \sqrt{(\alpha b (1 - \rho) R_p - B)^2 + 4B\alpha b \rho (1 - \rho) R_p}}{2\alpha b (1 - \rho)} \]

- This is the tradeoff between bandwidth and buffer
- Provides incentive for appropriate buffer size selection
Price vs. Buffer Size

Top line: 43.9% utilization; Bottom line: 26.3% utilization
Future Business Models?

- Internet 2
  - Public goods model
  - Cooperation among government, universities, and industry
  - Overprovisioning of capacity
- Global Internet
  - Liberalization of Telecommunications Policy
The Abilene Network
The Importance of Internet 2

- Smaller universities find Internet 2 more important
- Universities that integrate telecom and data networking find Internet 2 more important

\[
\text{IMPORT} = \beta_0 + \beta_1 \text{PRIVATE} + \beta_2 \text{STUDENTS} + \\
\beta_3 \text{HOPS} + \beta_4 \text{FUNDING} + \beta_5 \text{URBAN} + \\
\beta_6 \text{TRAFFIC} + \beta_7 \text{INTEGRATE}
\]

- \(\beta_2\) (-) and \(\beta_7\) (+); \(p < 0.05; N = 49\)
Global Traffic Flow

Source: InternetTrafficReport.com
## Global Internet Penetration

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Expected sign</th>
<th>Actual sign</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
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<td>H2</td>
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</tbody>
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Conclusions

- Incomplete Contracts and Externalities are problematic
- Integration may solve some problems including security
- More regulation is unlikely
- Ex-Post pricing may solve some potential security problems in a market context