The economics of the Internet

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Main points:

• Revenue minnow (Internet) is in the process of swallowing the revenue whale (voice)

• Economics, user preferences, and regulation will be more important than technology

• Many tricky transition issues:
  – high uncertainty
  – stubborn adherence to misleading myths
  – struggles for control
  – …
Frequent reluctance to face reality:

Number of papers per year with ATM or Ethernet in the abstract, data from IEEE Xplore (2004) (estimated values for 2004).

A few macro issues:

• what are the costs and incentives?
• who is being served?
• what is the service?

• giant disparities in volume, value, and revenue
4 dimensions of communications technology:

• volume: How much data can it transmit?

• transaction latency: How long does it take to do something?

• reach: Where can the service be provided?

• price: How much does it cost?

• reliability, …
Network technologies and architectures:

- irrelevant to users
- cannot compensate completely for weaknesses of applications
Size of telecom industry:

- world GDP: approx. $70,000 B
- world telecom service revenues almost $2,000 B
- world advertising: approx. $500 B

- Google worldwide 2011 revenues: $38 B
Revenue per MB (v. approximate):

- SMS: $1,000.00
- cellular calls: 1.00
- wireline voice: 0.10
- residential Internet: 0.01
- backbone Internet traffic: 0.0001
Telecom Costs

Traditional

Future

- Long Distance
- Switching
- Access
Where are the money and the traffic?

- world revenues: more than half from wireless
- world revenues: mostly from voice, texting second
- traffic: about 40,000 PB/month at year-end 2012, around 5% from wireless, under 1% from voice
- Level 3 (incl Global Crossing and CDN arm): around 10% of world traffic, 2011 revenues of $6 B
- Akamai: 2011 revenues of $1.2 B
Huge potential sources of additional Internet traffic:

- storage
  - hard disk content would take several years to transmit over the Internet
- broadcast TV (incl cable)

- but how much are people willing to pay for it?
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<th>texts</th>
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<tr>
<td>2011</td>
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</table>
Two key delusions in one phrase:

Net neutrality “is about streaming movies.”

*Jim Cicconi, AT&T, 2006*
Dreaming of streaming:

Vacuum Cat
Key misleading myth: streaming real-time traffic

- little demand for truly real-time traffic
- for most traffic, faster-than-real-time progressive transfer wins:
  - far simpler network
  - enables new services
  - takes advantage of growing storage
Function of data networks:

To satisfy human impatience
Utilization of a T1 link to the Internet

Sunday

Monday

Percentage utilization

Time in hours

24 6 12 18 24 6 12 18 24
Function of data networks:

To satisfy human impatience: average US wireline customer downloads about 50 GB/month, which is about 150 Kbps over that period, about 1.5% of 10 Mbps link
Quantitative measures:

- Sarnoff’s Law: Value of content distribution network grows like \( n \)
- Metcalfe’s Law: Value of connectivity network grows like \( n^2 \)
- Briscoe, Odlyzko & Tilly: Metcalfe’s Law wrong, value of general connectivity network grows like \( n \times \log(n) \)

\( n \times \log(n) \) grows faster than \( n \), but difference is sufficiently slow to enable the “content is king” dogma to persist

\( n = \text{number of participants} \)
Other quantitative heuristics:

- Value of bandwidth (or computing, or storage) as proportional to log of raw capacity: 10 bps, 1 Kbps, 1 Mbps, and 1 Gbps links have approximate values 1, 3, 6, and 9

- Locality: gravity models, with intensity of interaction between populations of sizes X and Y at distance d proportional to X*Y/d
Implications of current growth rates:

- Wireline requires continued innovation and investment.
- Wireline does not require big capex increases.
- "Muddling through" appears feasible and likely: can get to "natural evolution" state.
- Wireless may well be different.
Implications of wireless data growth:

- old issues (QoS, net neutrality) to be revisited, with possibly different outcomes
- expectations of seamless transition from wireline to wireless unrealistic
- innovation seeks profits, so may shift to wireless, and to low-bandwidth access
- future traffic levels result of interaction of complex feedback loops
Conclusions:

• Communications extremely important

• Natural evolution: ‘dumb pipes,’ ‘waste that which is plentiful’

• Continuing tussles over money and control

• Wireless may go counter to general trend, with QoS finally making major inroads

• future of industry result of interaction of complex feedback loops
Further data, discussions, and speculations in papers and presentation decks at:

http://www.dtc.umn.edu/~odlyzko