The economics of the next great telecom revolution

Andrew Odlyzko

School of Mathematics and
Digital Technology Center
University of Minnesota
http://www.dtc.umn.edu/~odlyzko

Main points:

- Next great revolution: convergence of wireless and IP

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

- Success by mistake to continue:
  - high uncertainty
  - stubborn adherence to misleading myths
  - struggles for control
  - …

Digital Technology Center

UNIVERSITY OF MINNESOTA

Frequent reluctance to face reality:
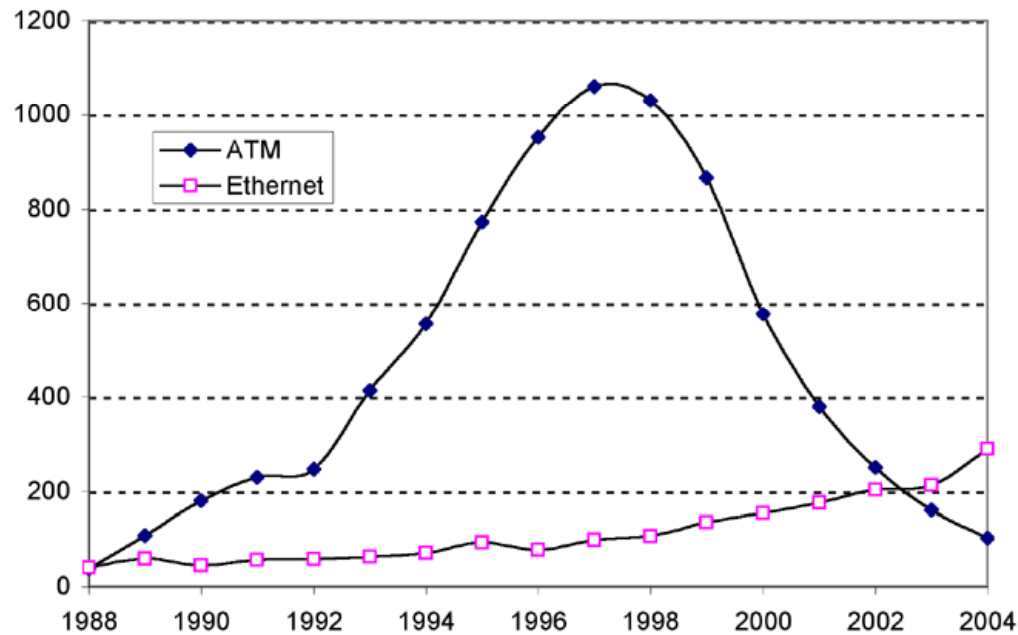
Number of papers per year with ATM or Ethernet in the abstract, data from *IEEE Xplore* (2004) (estimated values for 2004).

Kalevi Kilkki, Sensible design principles for new networks and services, First Monday, Jan. 2005, http://www.firstmonday.org/issues/issue10_1/kilkki

Digital Technology Center

3

UNIVERSITY OF MINNESOTA

Wrong predictions about online search:

The goals of the advertising business model do not always correspond to providing quality search to users. ... we expect that adertising funded search engines will be inherently biased towards the advertisers and away from the needs of the consumers. ... we believe the issue of advertising causes enough mixed incentives that it is crucial to have a competitive search engine that is transparent and in the academic realm.

Being wrong is not necessarily fatal:

The goals of the advertising business model do not always correspond to providing quality search to users. ... we expect that adertising funded search engines will be inherently biased towards the advertisers and away from the needs of the consumers. ... we believe the issue of advertising causes enough mixed incentives that it is crucial to have a competitive search engine that is transparent and in the academic realm.

Sergey Brin and Larry Page, 1998

Telecom industry hobbled by many misleading dogmas:

- Carriers can develop innovative new services

- Content is king

- Voice is passe

- Streaming real-time multimedia traffic will dominate

- There is an urgent need for new "killer apps"

- Death of distance

- QoS and measured rates

Human communication:

One picture is worth
a thousand words.

Human communication:

One picture is worth a thousand words, provided one uses another thousand words to justify the picture.

Harold Stark, 1970

Content vs. connectivity:

◆ Long historical tradition of overemphasis on content

◆ Connectivity has traditionally been valued much more than content

◆ Social connectivity very important but neglected

Note: Content (defined as material prepared by professionals for wide distributions) is big and important, it is just not as big or as important as connectivity.

Digital Technology Center

UNIVERSITY OF MINNESOTA

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*log(n)

n*log(n) grows faster than n, but difference is sufficiently slow to enable the "content is king" dogma to persist

n = number of participants

Content vs. connectivity conclusions:

◆ Content is valuable

◆ Content not as valuable as connectivity

◆ Social content-enriched connectivity should be promoted

Telecom of last decade (conventional view):

2 giant disasters: long-haul fiber buildout

and European 3G spectrum auctions

1 qualified success: Google

"Google envy"

Disasters overshadowed by great telecom success:

- US wireless: from $69 B in 1998 to $148 B in 2008

- US wireless data services in 2008: $32 B (mostly SMS, included in $148 B)

- Google worldwide 2008 revenues: $22 B

Wrong lessons drawn from wireless:

- ◆ industry view: profits from tight control of wireless vs losses from the wild and uncontrolled Internet

- ◆ reality: success from providing mobility for voice and simple text messaging

- ◆ wireless voice and messaging provided in admirably net-neutral fashion

- ◆ usual reluctance to recognize reality

- ◆ continued fixation on content and control

Voice:

- killer app of yesterday

- killer app of today

- killer app of tomorrow:
    - "orality of human culture"
    - sadly neglected
    - many still unexploited enhancements (higher quality, …)
    - …

Revenue per MB:

- SMS: $1,000.00

- cellular calls: 1.00

- wireline voice: 0.10

- residential Internet: 0.01

- backbone Internet traffic: 0.0001

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
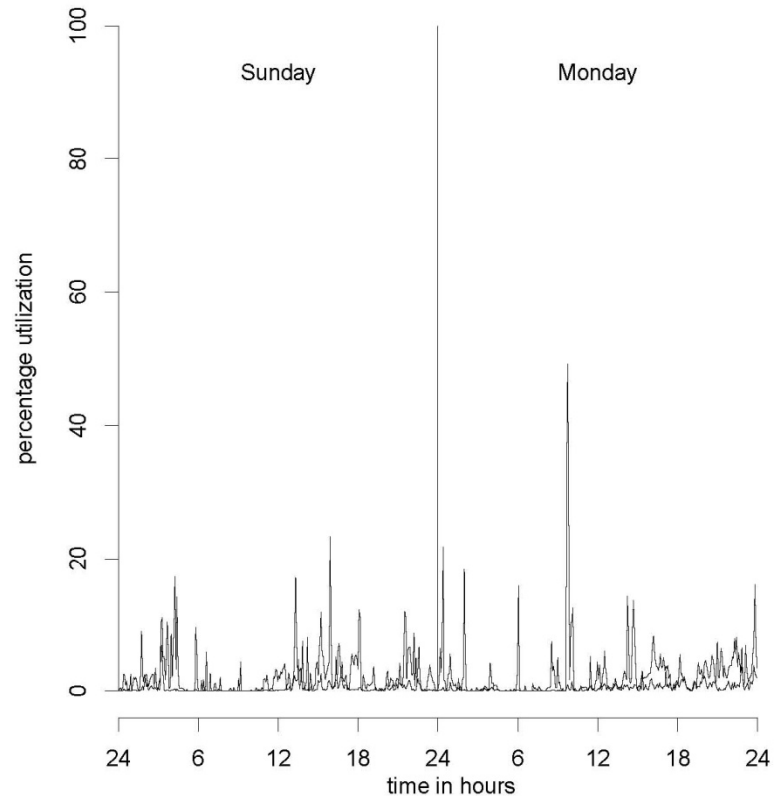 - takes advantage of growing storage

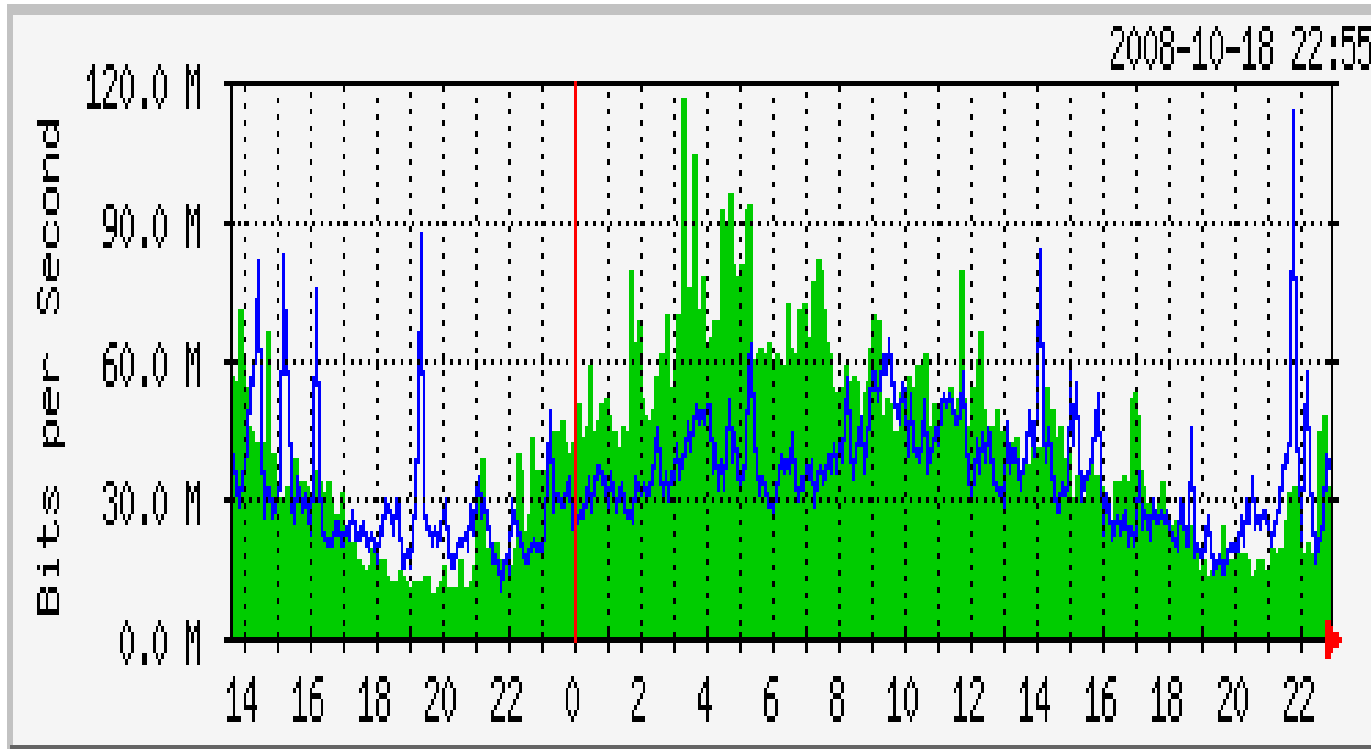# *Function of data networks:*

To satisfy human impatience

Human impatience has no limit:

Therefore there is no limit to bandwidth that might not be demanded eventually (and sold profitably).

Utilization of a T1 link to the Internet

"Waste what is plentiful"

Natural evolution of telecom networks:

◆ dumb pipes

◆ overprovisioned

"Waste that which is plentiful"

George Gilder

◆ dominated by cascades of computer-to-computer interactions, driven by human impatience

◆ horizontal layering, structural separation

◆ market segmented by size of (dumb) pipe

Minnesota Internet Traffic Studies (MINTS)

📶MINTS News

- **Mar 18, 2009** [Possible further slowdown in wireline traffic growth, continued (and possibly unsustainable) growth in wireless data traffic](#)

- **Feb 8, 2009** [MINTS pages updated to year-end 2008, some new reports](#)

- **Nov 23, 2008** [Several traffic reports: As before, the only visible floods are in wireless](#)

[More](#)

Current (year-end 2008) annual Internet traffic growth rates	
U.S.	50-60%
World	50-60%

Year-end 2008 monthly Internet traffic estimate	
U.S.	1,200-1,800 PB (PetaByte = 10^{15} bytes)
World	5000-8000 PB (PetaByte = 10^{15} bytes)

Year-end 2008 estimates for monthly Internet traffic (GB per capita)	
Australia	1.0
Western Europe	3.2
Japan	3.5
U.S.	5.0
Hong Kong	20.0
South Korea	24.0

Estimates for Australia and Hong Kong are based on official government

Digital Technology Center

UNIVERSITY OF MINNESOTA

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

Wireless data:

- many signs of explosive growth (500+% in some cases)

- start from small base (1% of wireline)

- already comparable to wireless voice in volume

- overall growth rate 100+%

- growth rates of even 100% per year likely not sustainable without huge increases in capex

Wireless data (cont'd):

- wireless data about equal to wireless voice in volume

- low willingness to pay for wireless data (except for messaging and a few other services)

- huge volumes of wireline traffic that users would happily handle via radio

- wireless transmission gains lag behind photonics

- mismatch between wireline and wireless bandwidth to persist

Implications of wireless data growth:

- old issues (QoS, net neutrality) to be revisited, with possibly different outcomes

- high value of mobility may bring big new revenues

- expectations of seemless 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

Implications of wireless data growth (cont'd):

- possible kludgy solutions with multiple networks (appeal of all-IP uniform network vs need to protect high-value voice services)

- faster growth and larger pie with innovation of open architecture vs drive to control (iPhone and its app store)

- unavoidable and unsolvable tussles between large players

- technology likely to be overshadowed by economics and regulation

- much frustration for users and technologists

Implications for new service creation:

- don't forget voice!

- forget streaming (except for voice and videoconferencing)

- exploit locality

- privacy erosion to continue (jerkily)

- …

Further data, discussions, and speculations in papers and presentation decks at:

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