

False dogmas and real incentives on the Internet

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Preliminary points:

- Technological predictions hard
 - ⇒ need for flexibility
- Some long-running trends likely to persist
(such as growth in share of medicine, education, and possibly telecom, and, at least over shorter time periods, in Moore's laws for processing, storage, transmission, etc.)
- False myths often have surprisingly long lives
(we keep repeating old mistakes)

Mistaken predictions:

The goals of the advertising business model do not always correspond to providing quality search to users. ... we expect that advertising funded search engines will be inherently biased towards the advertisers and away from the needs of the consumers. ... But 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.

Overwhelming need for flexibility in technology and business plans:

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- Sergey Brin and Larry Page, 1998

Long-lived and pernicious myths:

- 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”
- QoS and measured rates

Revenue per MB:

• SMS:	\$1,000.00
• cellular calls:	1.00
• wireline voice:	0.10
• residential Internet:	0.01
• backbone Internet traffic:	0.0001

- Volume is not value, but is an indicator of ecosystem health and growth!
- Net neutrality is not about video

Turmoil and confusion in telecom:

- Technology changing
- Service providers fighting the natural evolution that would make them “just pipe providers”
- Many false myths, some spread for political reasons, others deeply embedded in minds of public and decision makers

Dominant types of communication: business and social, not content, in the past as well as today

Thirty years ago you left the city of Assur. You have never made a deposit since, and we have not recovered one shekel of silver from you, but we have never made you feel bad about this. Our tablets have been going to you with caravan after caravan, but no report from you has ever come here.

circa 2000 B.C.

A fine thing you did! You didn't take me with you to the city! If you don't want to take me with you to Alexandria, I won't write you a letter, I won't talk to you, I won't say Hello to you even. ... A fine thing you did, all right. Big gifts you sent me - chicken feed! They played a trick on me there, the 12th, the day you sailed. Send for me, I beg you. If you don't, I won't eat, I won't drink. There!

circa 200 A.D.

Content vs. connectivity:

- Telecom spending in US: over \$300 B/yr
- Movie theater ticket sales in US: under \$10 B
- Recorded music sales: around \$10 B

Content vs. connectivity:

At a briefing last week with Takeshi Natsuno, one of the principal architects behind DoCoMo's wildly successful 1999 launch of i-mode, one message became abundantly clear: **content is not king**.

Times Online, October 17, 2007

Only half a dozen years and \$200 billion late: see "**Content is not king**," First Monday, Feb. 2001

Human communication:

One picture is worth a thousand words

Key role of voice communication:

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

Harold Stark, 1970

Voice is extremely important in human communication. Much more can be done with it (such as higher quality, or several levels of quality, or voice messaging).

A key misleading myth: streaming real-time traffic

Keynote speech by SIGCOMM 2004 lifetime contribution award winner Simon Lam,

<http://www.acm.org/sigs/sigcomm/talks/lam-sigcomm04.pdf>

Lam's conclusions:

1. Overprovisioning not a solution
2. Flow-oriented service needed
3. More QoS research is needed
4. Widespread commercial deployment of QoS within 10 years

All 4 are almost surely wrong! (And go counter to the correct statement on Slide #2 of Lam's presentation that "IP won the networking race.")

Dominant form of traffic now and in the future: file transfers

multimedia to go faster than real-time (with no obvious limit on speed or bandwidth needed to get low transaction latency)

even with limited memory, buffers substitute for QoS

small fraction of traffic that is inherently real-time (voice telephony, videoconferencing) can be handled in several ways

responds to human impatience, which is the driving force behind development of data networks

predicted long ago
vindicated by Napster, ...

Faster-than-real-time file transfers:

- Leads to simpler networks
- Enables new services
- Is how all packet networks work at the micro scale
- So why isn't this natural usage dominant in network planning?

Exafloods and the “imminent collapse of the Internet”:

- Reports and press coverage of rapidly growing traffic choking the Internet
- Little reliable data
- Much disinformation, and ignorance, combined with gross innumeracy and lack of understanding of technology advances

Minnesota Internet Traffic Studies (MINTS)

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[Methodology](#)

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[People](#)

Current (mid-2007) annual Internet traffic growth rates

U.S.	50-60%
World	50-60%

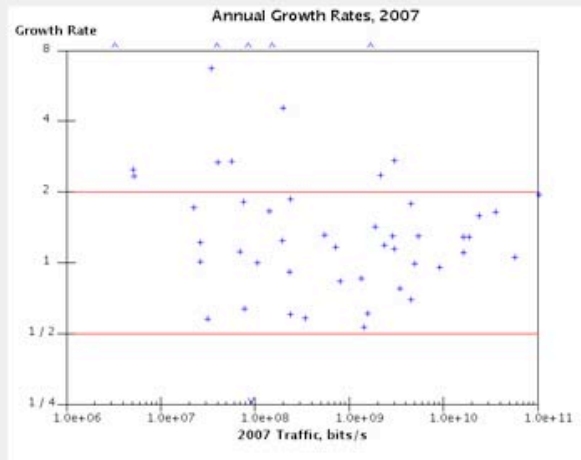
Year-end 2006 monthly Internet traffic estimate

U.S.	450-800 PB (PetaByte = 10^{15} bytes)
World	2000-3000 PB (PetaByte = 10^{15} bytes)

Year-end 2006 estimates for monthly Internet traffic (GB per capita)

Australia	0.7
Western Europe	1.5
Japan	2.0
U.S.	2.0
Hong Kong	13.5
South Korea	12.0

Estimates for Australia and Hong Kong are based on official government statistics, while that of Japan is derived from cooperative ISP data collection in that country. In all cases, extrapolations were made to provide estimates for year-end 2006. Figures for other countries are based on snippets of information of varying degrees of reliability, as well as confidential reports by some service providers.



Traffic growth rates from publicly observed sites

See [Data](#) for more detailed information and [Methodology](#) for descriptions and definitions.

<http://www.dtc.umn.edu/mints>

ESnet: longest available run of reliable traffic statistics:

Traffic accepted by ESnet in June of each year

year	TB
1990	0.079
1991	0.187
1992	0.437
1993	0.628
1994	1.72
1995	2.82
1996	2.81
1997	4.61
1998	8.83
1999	18.8
2000	35.7
2001	43
2002	103
2003	166
2004	282
2005	470
2006	1210
2007	2670

1990 to 2007 compound annual growth rate: 85%

Hong Kong: intriguing slowdown

year	growth rate in Internet traffic over the previous year, for October of each year
2002	182%
2003	377
2004	172
2005	68
2006	29
2007	21

Per-capita traffic intensity in Hong Kong is about 6x the U.S. level.

Huge potential sources of additional Internet traffic:

- Storage
 - Year-end 2006 worldwide digital storage capacity: 185,000 PB
 - Year-end 2006 worldwide Internet traffic: about 2,500 PB/month
- Broadcast TV
 - Year-end 2006 U.S. Internet traffic per capita: 2 GB/month
 - Year-end 2006 U.S. TV consumption per capita: 40 GB/month
(soft figure, assumes 3 hr/day, at 1 Mbps, no HDTV, ...)

Traffic growth:

- Currently around 50% per year in US and world-wide
 - 50% traffic growth combined with 33% cost decline yields static revenues
- ⇒ key incentive for industry is to promote traffic growth

Promoting traffic growth:

- New applications
- Network effects
- Pricing
 - Industry is desperately trying to shoot itself in the foot with plans for metered pricing, such as those announced by Time Warner

Market action opposed to rhetoric:

THE NEW YORK TIMES, THURSDAY, FEBRUARY 21, 2008

MARKET PLACE

Cellphone Carriers Test All-You-Can-Talk Menus

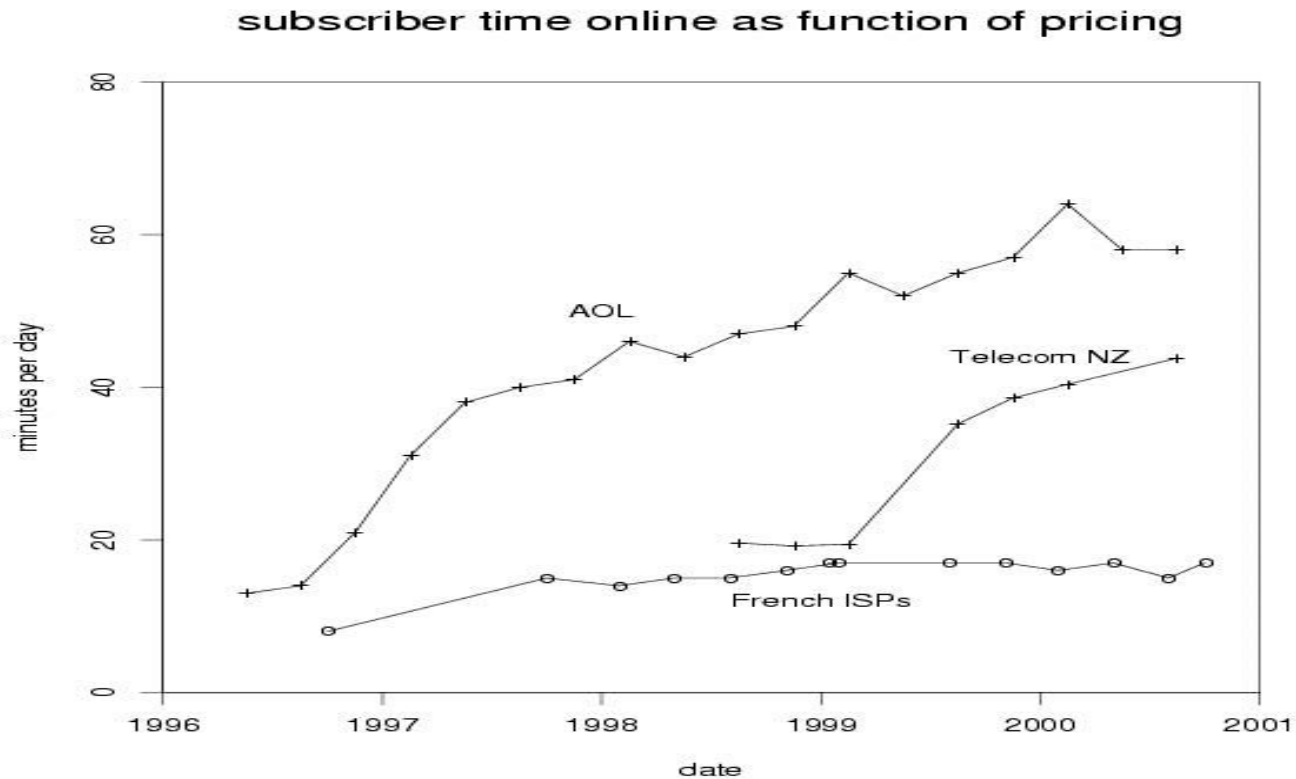
By BRAD STONE

A PRICE war among cellphone carriers is giving users a chance to stop counting their minutes. In recent days, three large cell-

cellphone service, depending on the addition of data services like e-mail, according to a study by J. D. Power & Associates.

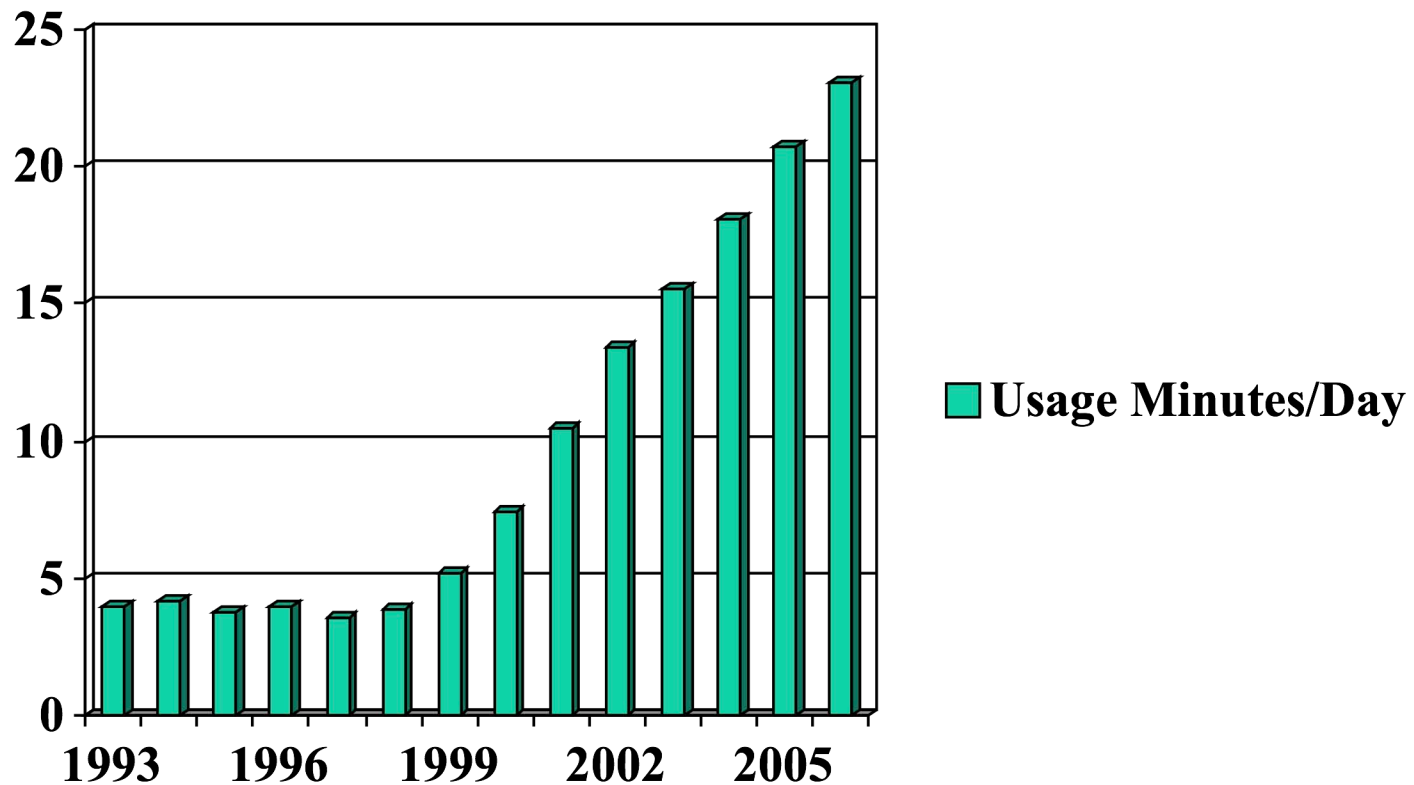
Instead, the fixed-rate plans are aiming for the small yet valu-

Flat rates as a way to stimulate usage:



US leadership in wireless voice :

U.S. cell phone usage, minutes per day around June of each year.



Content to connectivity:

- from binary, content or connectivity
- to continuum, from content to connectivity
incl. Zipf and general power laws

Next steps in evolution of Internet:

- fuller integration of broadband into social communication
 - better tools
 - free video
 - exploit locality
- without forgetting voice

Blockbusters vs. “long tail”:

- Zipf and Pareto laws
 - among billion items, most valuable thousand account for 1/3 of value
- room for both blockbusters and “long tail”
- challenge: spanning the gap

Locality and location:

- “The Earth is flat” and “death of distance” are only half-true
- Locality matters for communication
- Location of storage and computation may or may not be coupled to location of communicating parties (P2P vs “cloud computing”)

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

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