Future Internet:
Drastic change, or muddling through?

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Predictions for wireline network:

- 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

The Big Question:

Is the Internet threatened by

too much

or

too little

traffic?

Internet traffic as pulse of the Internet:

- Wireline traffic growth slowing
- Hype accelerating
- Even very biased hype is occasionally correct: trustworthy data collection desirable
- There are huge sources of potential future traffic
- Future traffic levels result of interaction of complex feedback loops

Current US and world Internet traffic:

- Wireline growth rates mostly in the 50-60% per year range
- Cisco white paper: 40% CAGR prediction
- Mobile data growth 100+%
- Mobile data around 1% of wireline data
- 50% growth rate in traffic only offsets 33% cost decline:
  - traffic: 100 $\Rightarrow$ 150
  - unit cost: 100 $\Rightarrow$ 67
  - total cost: 10,000 $\Rightarrow$ 10,050

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, ...)

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Minnesota Internet Traffic Studies (MINTS)

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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

Qwest grim prediction for Internet traffic:

Pieter Poll, Qwest CTO, in OFC/NFOEC plenary, Feb. 2008:

- IP traffic to go from 9 PB/day in 2007 to 21 PB/day in 2012
- but that is 18.5% CAGR!!!

http://www.ofcnfoec.org/Materials/08_Plenary_Poll.pdf

Hong Kong: extreme and intriguing slowdown

year	growth rate in Internet traffic over the previous year, for February of each year
2002	304%
2003	154
2004	431
2005	122
2006	61
2007	30
2008	11

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

Canada (CRTC data):

year	growth over previous year
2006	53%
2007	44
2008	32

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Implications of current growth rates:

- Wireline requires continued innovation and investment
- Wireline does not require big capex increases
- “Muddling through” appears feasible and likely
- Wireless appears very different

Two key delusions in one phrase:

Net neutrality “is about streaming movies.”

Jim Cicconi, AT&T, 2006

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!

Streaming vs. progressive downloads:

Key misleading myth: streaming real-time traffic

- Little demand for truly real-time traffic
- For most traffic, faster-than-real-time 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).

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

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