The Exaflood:
Managing the coming digital deluge

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The Big Question:

Is the Internet threatened by

too much

or

too little

traffic?

Main points:

- Internet 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

Minnesota Internet Traffic Studies (MINTS)

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Current (year-end 2007) annual Internet traffic growth rates	
U.S.	50-60%
World	50-60%

Year-end 2007 monthly Internet traffic estimate	
U.S.	750-1250 PB (PetaByte = 10^{15} bytes)
World	3000-5000 PB (PetaByte = 10^{15} bytes)

Year-end 2007 estimates for monthly Internet traffic (GB per capita)	
Australia	1.0
Western Europe	2.3
Japan	2.6
U.S.	3.0
Hong Kong	17.0
South Korea	17.0

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 2007. Figures for other countries are based on snippets of information of varying degrees of reliability, as well as confidential reports by some service providers.

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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 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.

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

Current US and world Internet traffic:

- growth rates mostly in the 50-60% per year range
- Cisco white paper: 40% CAGR prediction
- Swanson-Gilder exaflood white paper: 55% CAGR prediction
- Nemertes white paper: about 100% CAGR prediction
- 50% growth rate in traffic only offsets 33% cost decline:
  - traffic: 100 ⇒ 150
  - unit cost: 100 ⇒ 67
  - total cost: 10,000 ⇒ 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, ...)

Cloud computing's limited prospects:

- cost, performance, and Moore's laws of computing, storage, and transmission
  - current growth rates of all 3 key technologies similar, ~50% per year
- transmission lagged historically, continues to do so
- residential users:
  - 3 Mb/s Internet downloads
  - 0.3 Mb/s Internet uploads
  - 3 Gb/s disks
  - 300 GB disk takes 3 months to upload at 0.3 Mb/s

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!

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

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