Internet growth myths

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Main conclusions:

1. Yes, there is a fiber glut

2. Internet traffic is growing vigorously, but "only" about doubling each year

   $\Rightarrow$ fiber glut will take a long time to be absorbed

3. Main implication of fiber glut: other factors ("last mile," provisioning) will dominate

Popular myth of astronomical growth rates:

"Internet traffic is doubling every three months."

Business Week, Oct. 9, 2000

"In 1999, data traffic was doubling every 90 days …"

Reed Hundt (former chairman, FCC)
You Say You Want a Revolution
Yale Univ. Press, 2000

But never any hard data to support these claims!

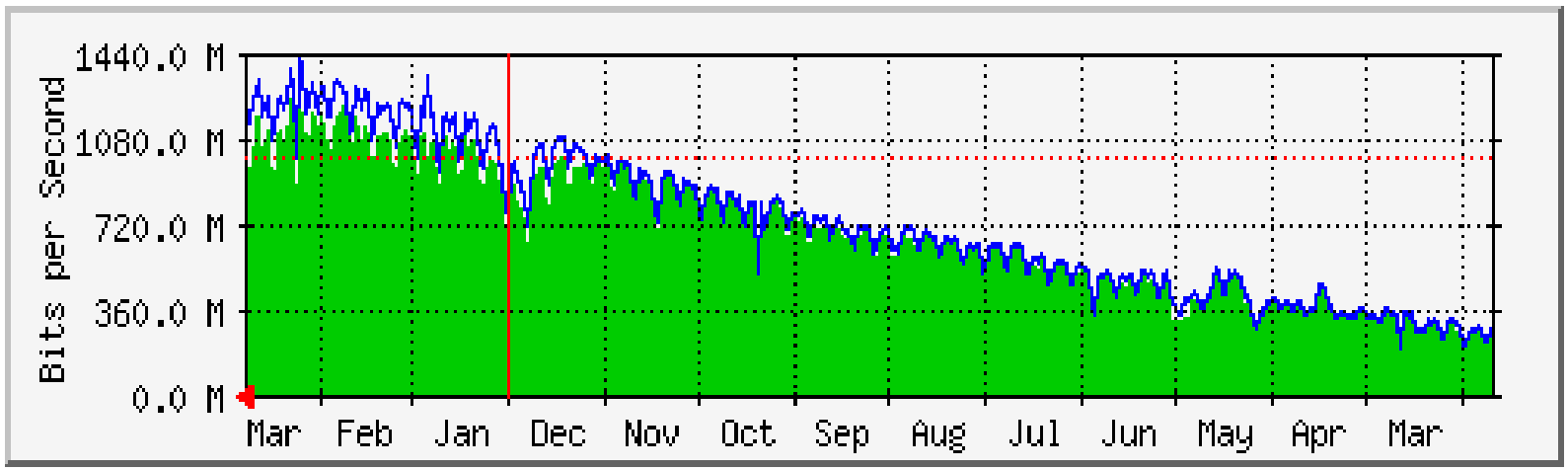
The myth and the reality:

"[LINX] traffic doubles every hundred days or so."

Keith Mitchell, executive chairman of LINX,
London Internet Exchange, Ltd., March 2000

But this is contradicted by data from a LINX web site:

LINX traffic, March 1999 to March 2000



LINX statistics show traffic taking about 230 days to double during this period! (Actual doubling time about 180 days.)

Widespread claims of Internet traffic doubling every three or four months are exaggerated. Actual U.S. backbone traffic appears to be doubling once a year.

"Traffic doubling each year" refers here to any growth rate between 70 and 150% per year. Imprecision caused by incomplete statistics. (The best statistics are probably those accumulated by the U.S. Department of Justice in connection with proposed Sprint-WorldCom merger, but those are not public.)

Capacity is growing faster than traffic.

Traffic on Internet backbones in U.S. For each year, shows estimated traffic in terabytes during December of that year.

year	TB/month
1990	1.0
1991	2.0
1992	4.4
1993	8.3
1994	16.3
1995	?
1996	1,500
1997	2,500 - 4,000
1998	5,000 - 8,000
1999	10,000 - 16,000
2000	20,000 - 35,000

Note: There was a period of traffic doubling every three or four months 1995-6 (cumulative growth 100× during those two years), but since then growth rate has reverted to doubling once each year.

Sources: Coffman and Odlyzko, The size and growth rate of the Internet (*First Monday*, October 1998)

Coffman and Odlyzko, Internet growth: Is there a "Moore's Law" for data traffic?, July 2000 (to appear in *Handbook of Massive Data Sets*, Kluwer, 2000)

Both reports available at

<http://www.research.att.com/~amo>

Data for 1990-94 based on careful and publicly available measurements for NSFNet, everything else based on extrapolations from limited evidence

The obvious implausibility of "doubling every 3 or 4 months":

Year-end 1994: reliable statistics on NSFNet:

approx. 15 TB/month of traffic
about 2 T3s coast-to-coast

Assume doubling every 3 months: by year-end 2000, would yield

250,000,000 TB/month
about 600,000 OC48s coast-to-coast

250,000,000 TB/month for no more than 150 million Internet users in US $\Rightarrow$1.6 TB/month per person (5 Mb/s average data flow around the clock per user)

A doubling every 4 months produces estimates only slightly less absurd

Could capacity be growing much faster than traffic? (Cf. claim from Mike O'Dell of UUNet that traffic is doubling each year, but network capacity has to double every 4 months, or grow 8x each year.)

UUNet official claim, downloaded March 24, 2001 from <http://www.uu.net/network/maps/northam/>:

> "UUNet now has enough OC12 (622 Mbps) miles to circle the earth 10 times!"

Assume that UUNet had 250,000 OC12-miles at year-end 2000.

If UUNet capacity grew 8x each year from year-end 1994, then it has grown by a factor of 2,097,152

$\Rightarrow$ In Dec. 1994, UUNet had 1/8-th of a mile of OC12 (50 T1-miles)

Implausible!

Example of misleading tidbit that feeds the myth of insatiable demand:

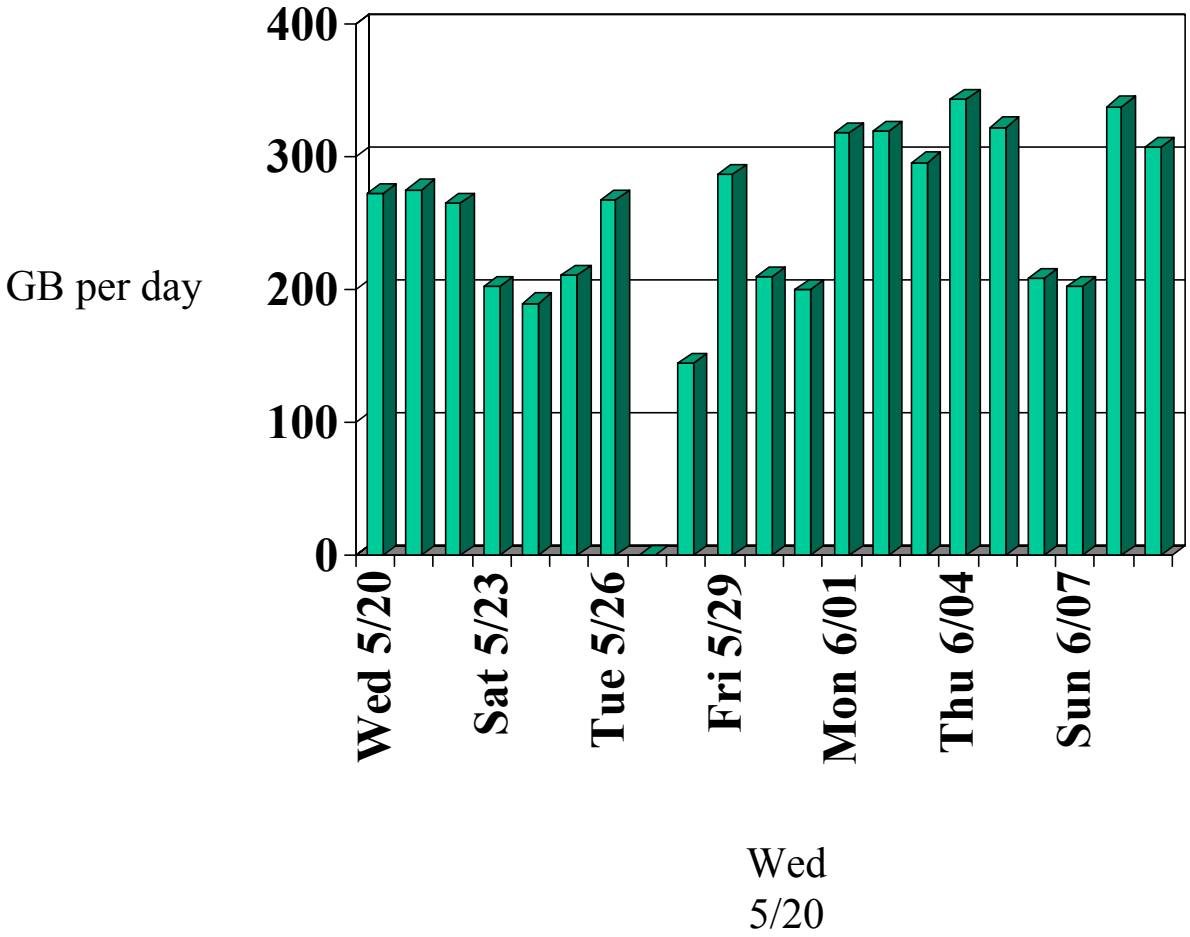
JANET (British research and academic network): current bandwidth to the US is 465 Mb/s (3 OC3s)

May 28, 1998: upgrade from a single T3 (45 Mb/s) to two T3s (90 Mb/s)

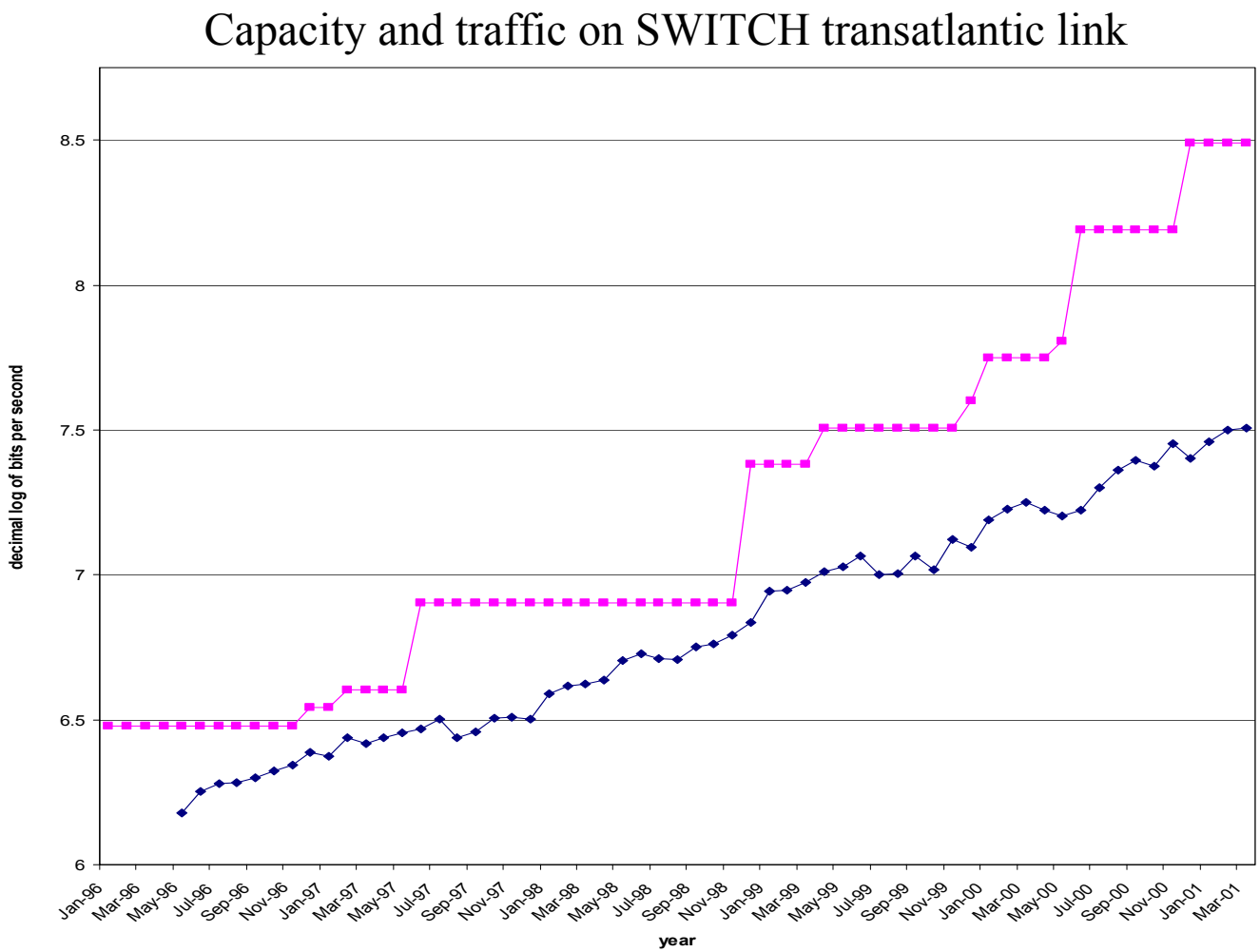
June 3, 1998 press release:

> Usage of the new capacity has been brisk, with the afternoon usage levels reaching in excess of 80 Mbit/s. This is of course evidence of the suppressed demand imposed by the single T3 link operating previously. The fact that usage has risen so quickly on this occasion is also indicative of the improved domestic infrastructures (i.e. SuperJANET III in the UK and the various GlobeInternet peering arrangements in Canada and the US) that now exist.

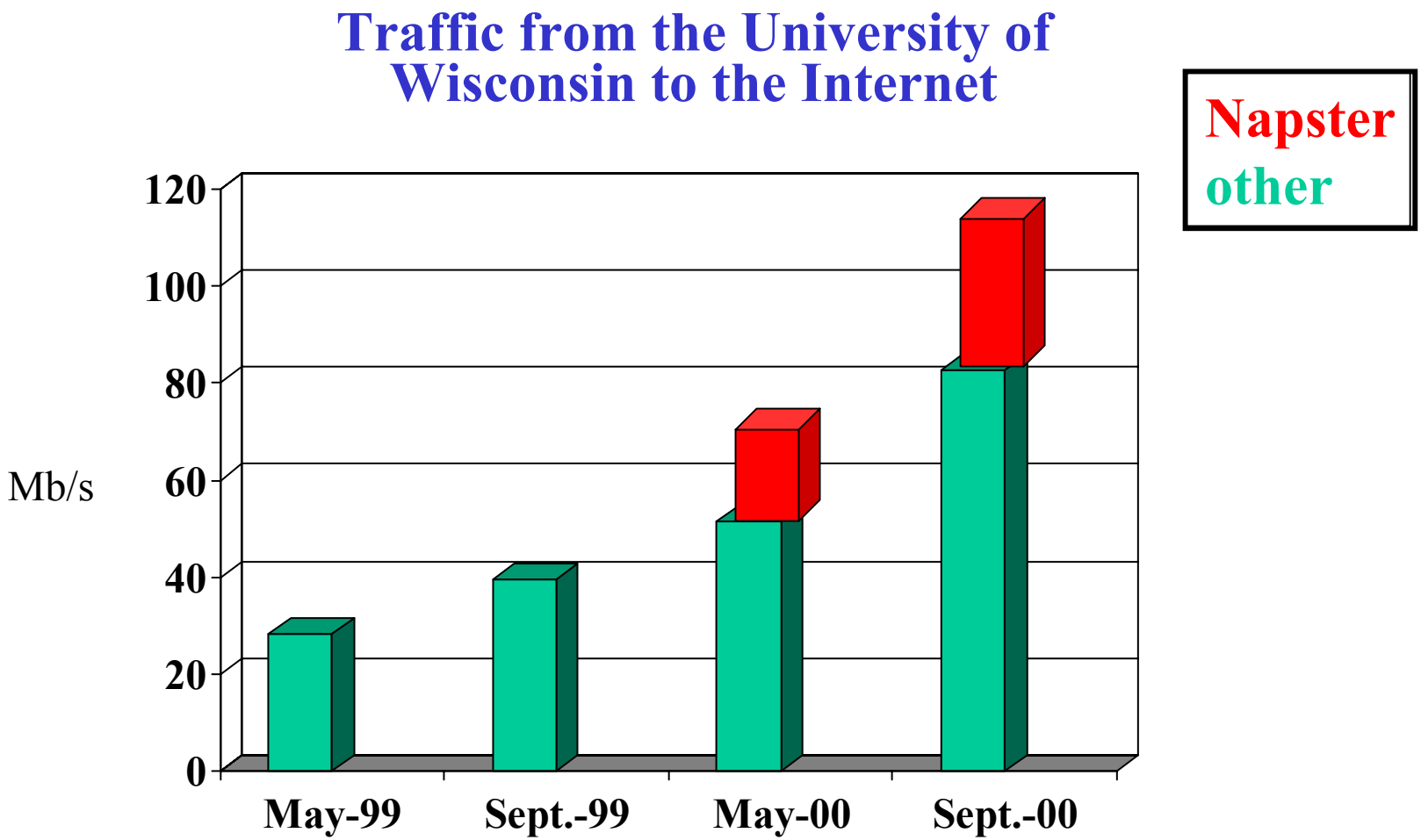
Actual traffic on JANET link from US to UK when link capacity was doubled in 1998, obtained from <http://bill.ja.net/>



SWITCH (Swiss academic and research network) traffic and capacity across the Atlantic (traffic shown only in the more heavily utilized US to Switzerland direction): Even dramatic increases in network capacity did not lead to traffic growing faster than about 100% per year.



Napster, just like WWW, is another disruptive phenomenon that helps sustain the growth of traffic at 100% per year:



General conclusion: IP traffic is growing at 70 to 150% per year.

Capacity is growing faster.

There was a slowdown in growth, but that occurred in 1997. Ever since, growth has been steady and rapid, although not as astronomical as popular mythology holds.

New applications (P2P, VoIP, …) promise continuation of a doubling of traffic each year.

Fiber glut does not solve the other obstructions (access and provisioning)

Even if those problems are solved, there appears to be a limit at which traffic is likely to grow, caused by the many other feedback loops operating on different time scales

More details in papers at

<http://www.research.att.com/~amo/doc/networks.html>

especially “Internet growth: Is there a “Moore’s Law” for data traffic?” (with Kerry Coffman)