Internet traffic growth: A gale or a hurricane?

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Broadband mantras:

You can never have too much bandwidth.

If you build it, they will come.

Key question for the industry: How quickly will they come?

Answer: Not as quickly as many hope.

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!

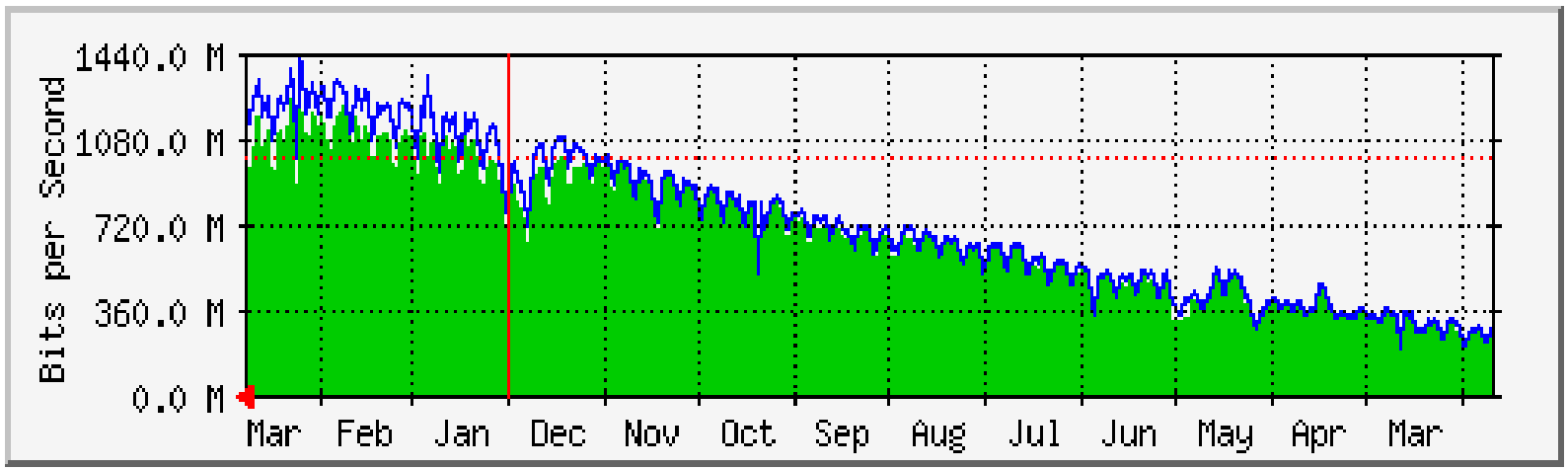
The myth and the reality:

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

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

But,

LINX traffic, March 1999 to March 2000



LINX statistics show traffic taking more than 200 days to double during this period!

General conclusion: Internet traffic about doubles each year, not each 3 and 4 months

Backbone traffic growth: about 100% per year in 1990 through 1994
about 1,000% per year in 1995 and 1996
about 100% per year in 1997 through 2000

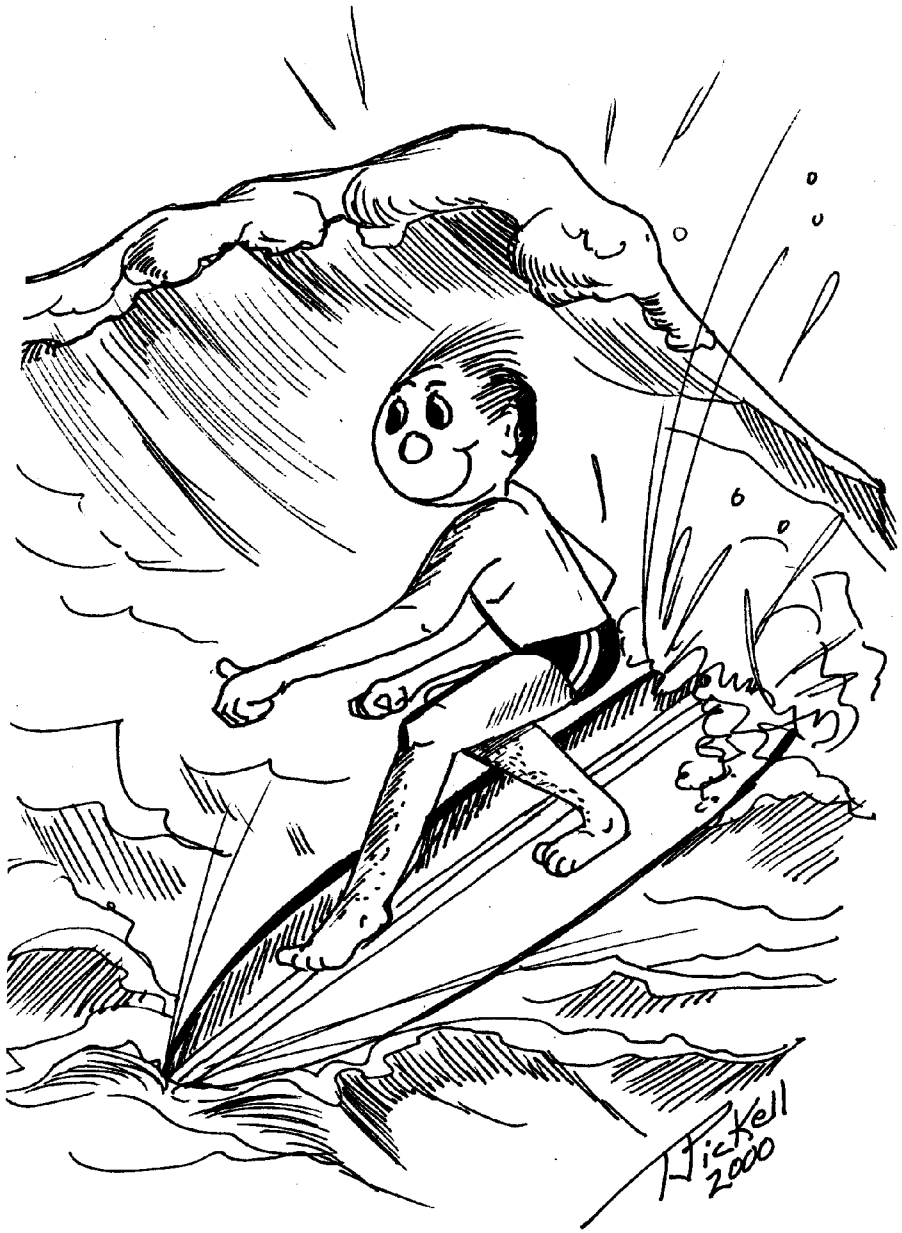
Overall data traffic growth: around 20 to 30% per year in the 1980s
30 to 40% per year in 1990 through 1998
accelerating towards 100% per year

A new form of "Moore's Law:" data traffic at large institutions tends to double each year, with great regularity

Example: incoming traffic to Merit network

date	millions of packets
Jan 1993	1115.7
Jan 1994	3047.3
Jan 1995	5284.8
Jan 1996	18515.9
Jan 1997	30319.5
Jan 1998	50024.7

"Doubling" is used in a loose sense, to cover rates of growth between 70% and 150%. This is rapid growth, much more rapid than in wired or wireless voice or traditional data, but not the astronomical 700% to 1,500% growth rates that a doubling of traffic every 3 or 4 months implies!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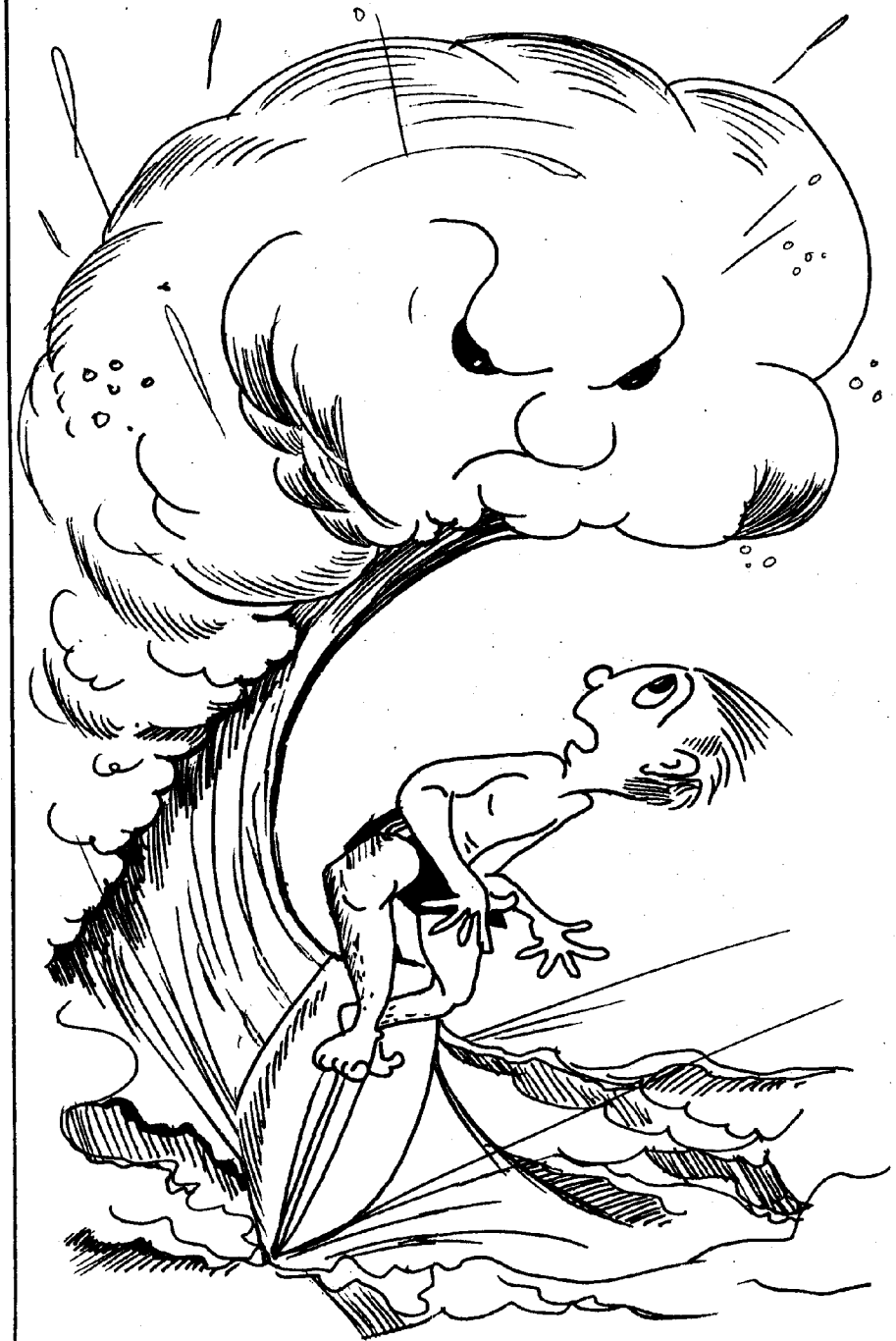
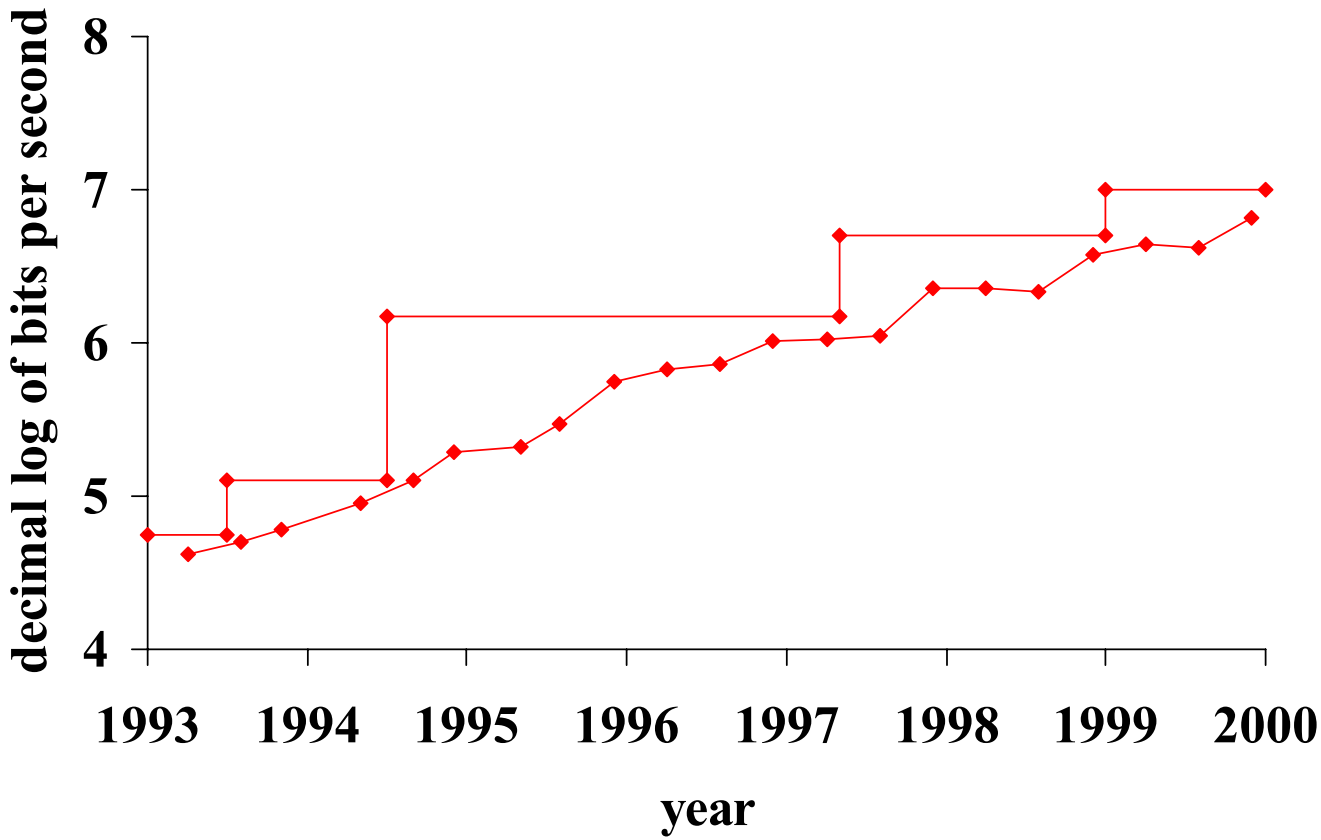


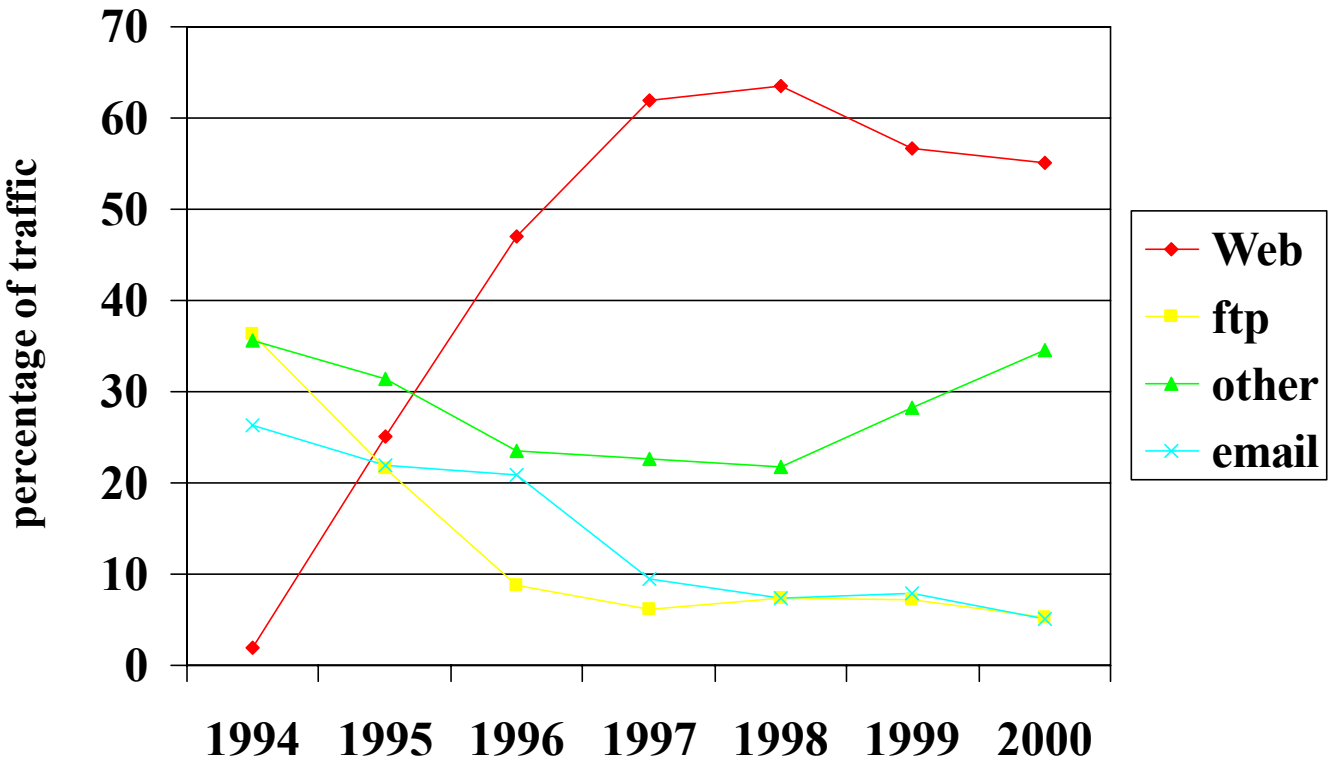
Traffic from the Internet to the University of Waterloo



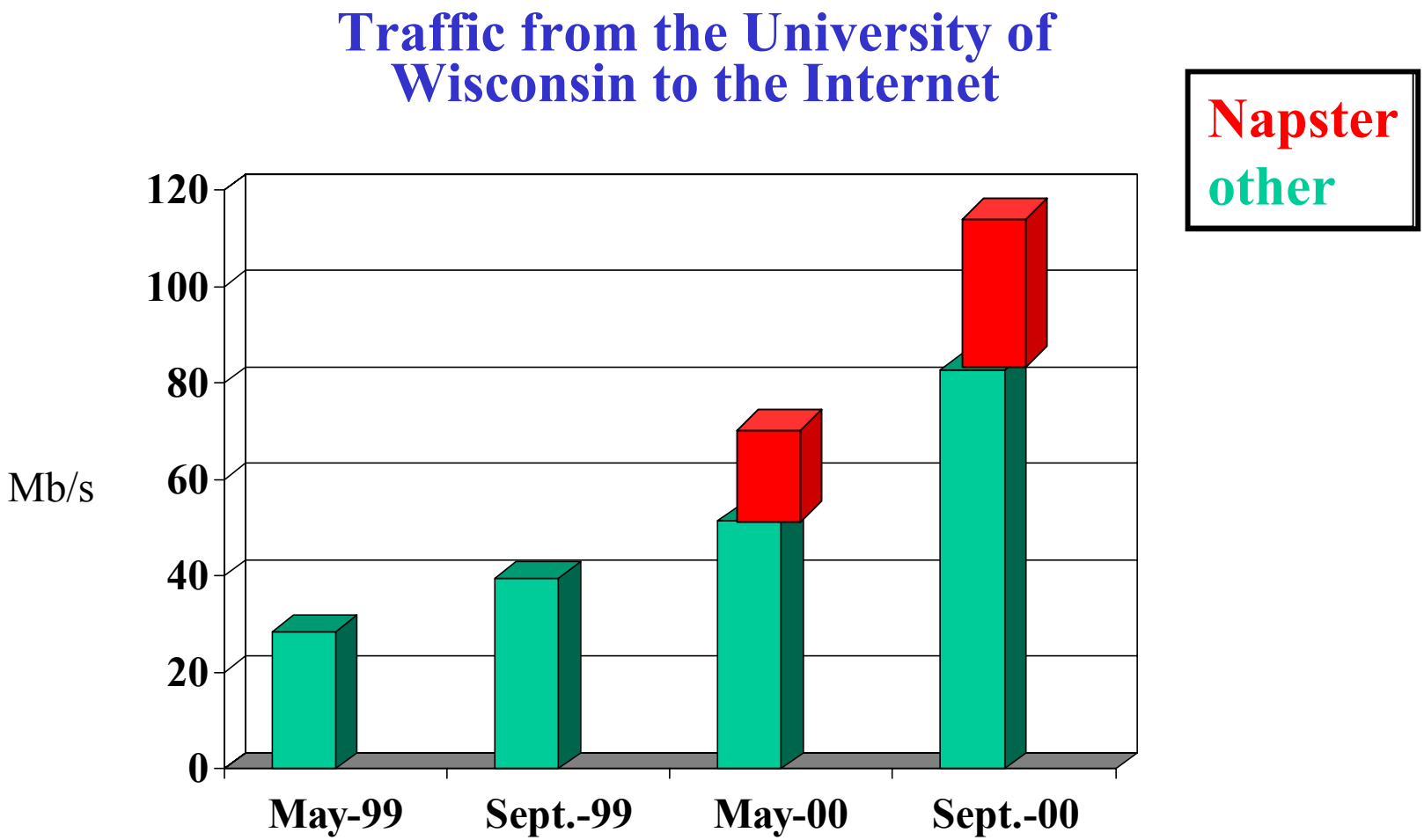
Doubling of traffic each year is disruptive:

- A 25-year IRU is really good only for 2 or 3 years
- Filling the pipes is the main imperative
- Careful traffic planning impossible
- ...

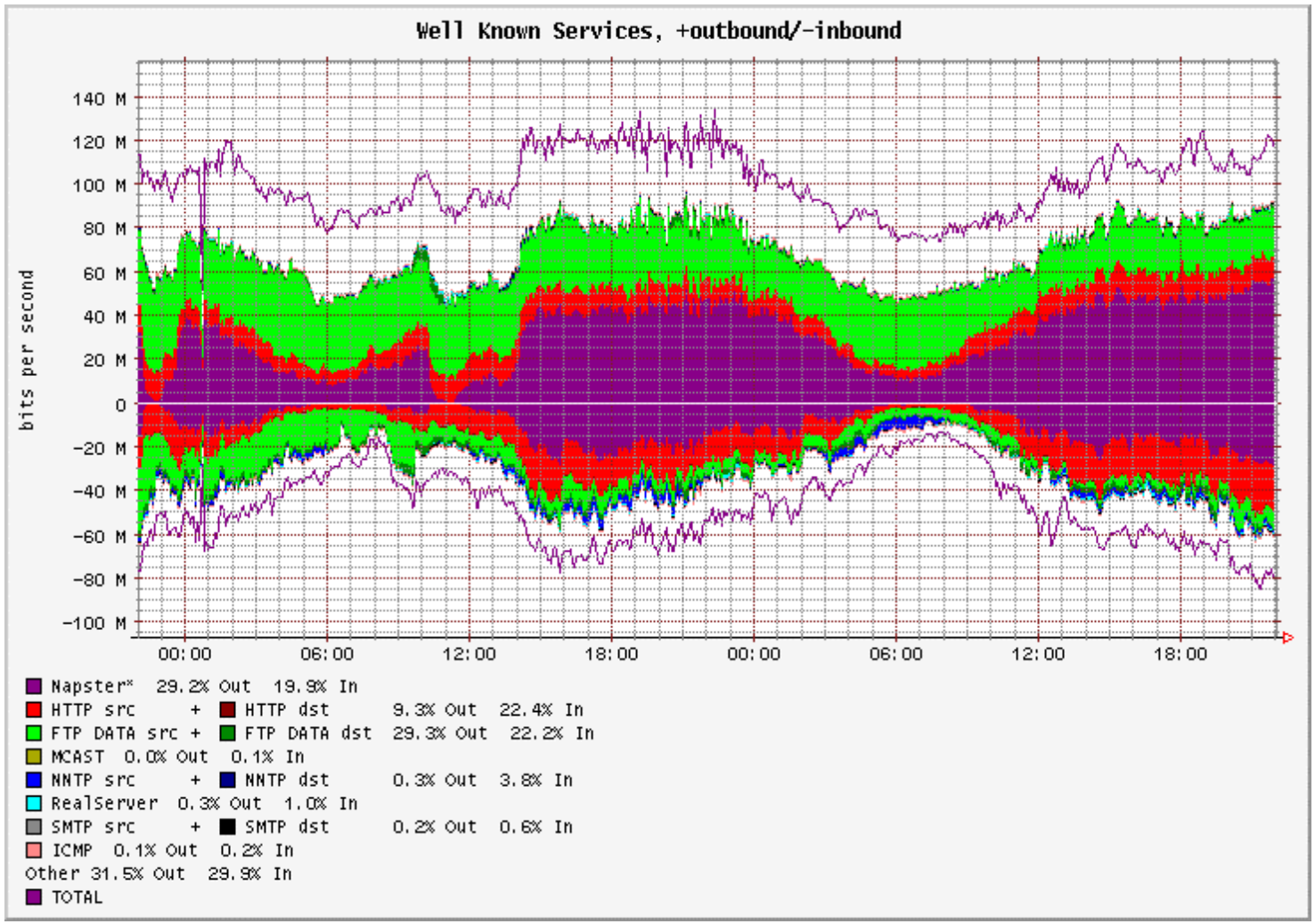
Internet Traffic at the University of Waterloo



Napster, just like WWW, is another disruptive phenomenon that helps sustain the growth of traffic:



The effect of Napster at the University of Wisconsin in Madison



Traffic is not the same as bandwidth

Factors decreasing bandwidth demand:

- Elimination of SONET rings, ATM “cell tax,” etc.
- VPNs over public network replacing private lines

Factors increasing bandwidth demand:

- Optical switching
- Demand for low transaction latency

Average utilization of LANs during the 1990s appears to have decreased by a factor of 10.

There is no fixed lower bound on average utilization.

DWDM is doubling transmission capacity of fiber each year, but magnetic storage is also doubling each year!

Worldwide hard disk drive market. (Based on Sept. 1998 and Aug. 2000 IDC reports.)

year	storage capacity (terabytes)
1995	76,243
1996	147,200
1997	334,791
1998	695,140
1999	1,463,109
2000	3,222,153
2001	7,239,972
2002	15,424,824
2003	30,239,756
2004	56,558,700

$\Rightarrow$ locality of traffic will still matter!

Conclusions:

"Internet traffic doubling every three months" is a fable -- there is about one doubling each year

Doubling each year is extremely high and disruptive growth

The regular growth rate comes from interaction of technology, economics, and sociology $\Rightarrow$ another "Moore's Law"

Transmission capacity is growing at about the same rate as traffic $\Rightarrow$ rough balance between supply and demand

Magnetic storage is doubling each year $\Rightarrow$ the predominance of storage over transmission will continue

Streaming media traffic is likely to be a small factor; local store and replay will dominate

More details in papers at

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

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