The paradoxes of broadband

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Broadband (and telecommunications in general) is full of paradoxes, puzzles, and mistaken beliefs

- **What is broadband?**
- **Can we afford it?**
- **Do we want it?**
- **What will we do with it?**
- **Should government make it a national priority?**

Broadband vs. narrowband: How are people voting with their pocketbooks?

U.S. data for December, 2001

broadband lines	**12.8M**
cell phones	**128.4M**

Narrowband mobility beat stationary broadband 10:1, even though prices were comparable

Deployment is not the big issue. Adoption rates matter far more

Adoption rates suggest broadband beats cell telephony in attractiveness

U.S. Broadband Lines		U.S. Cell Phones	
Dec 1999	2.8M	Dec 1989	3.5M
Dec 2000	7.1M	Dec 1990	5.3M
Dec 2001	12.8M	Dec 1991	7.6M
Dec 2002	19.9M	Dec 1992	11.0M
Dec 2003	27.0M (est)	Dec 1993	16.0M
		Dec 1994	24.1M

- **Thus broadband growth in three years equals that of cell phones in five years**
  → **cannot ignore technology adoption rates**
- **Internet time is a dangerous myth**

What is broadband?

FCC definition of broadband:

connections with speed exceeding 200 Kb/s in at least one direction

Under the official definition, we all have broadband connectivity courtesy of snail mail!

CD-ROMs via USPS deliver more data at same cost as a 1 Mb/s connection running at full capacity.

What matters most in communications:

- **volume**
- **transaction time**
- **reach**
- **price**

also:

- **isochronicity (easy byproduct of low latency)**

Volume and value only weakly related:

Revenue per MB for various services

Service	Typical monthly bill	Revenue per MB
Cable	$40	$0.00012
Broadband Internet	50	0.025
Phone	70	0.08
Dial Internet	20	0.33
Cell phone	50	3.50
SMS		3000.00

One picture is worth a thousand words

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

Harold Stark, 1970

There are still unexploited opportunities in voice, especially in 3G (with differentiated voice quality levels, etc.). The success of Nextel's push-to-talk should not have been a surprise (nor SMS).

A depressing litany of duds among major recent networking research initiatives:

- **ATM**
- **RSVP**
- **Smart markets**
- **Active networks**
- **Multicasting**
- **Streaming real time multimedia**
- **3G**

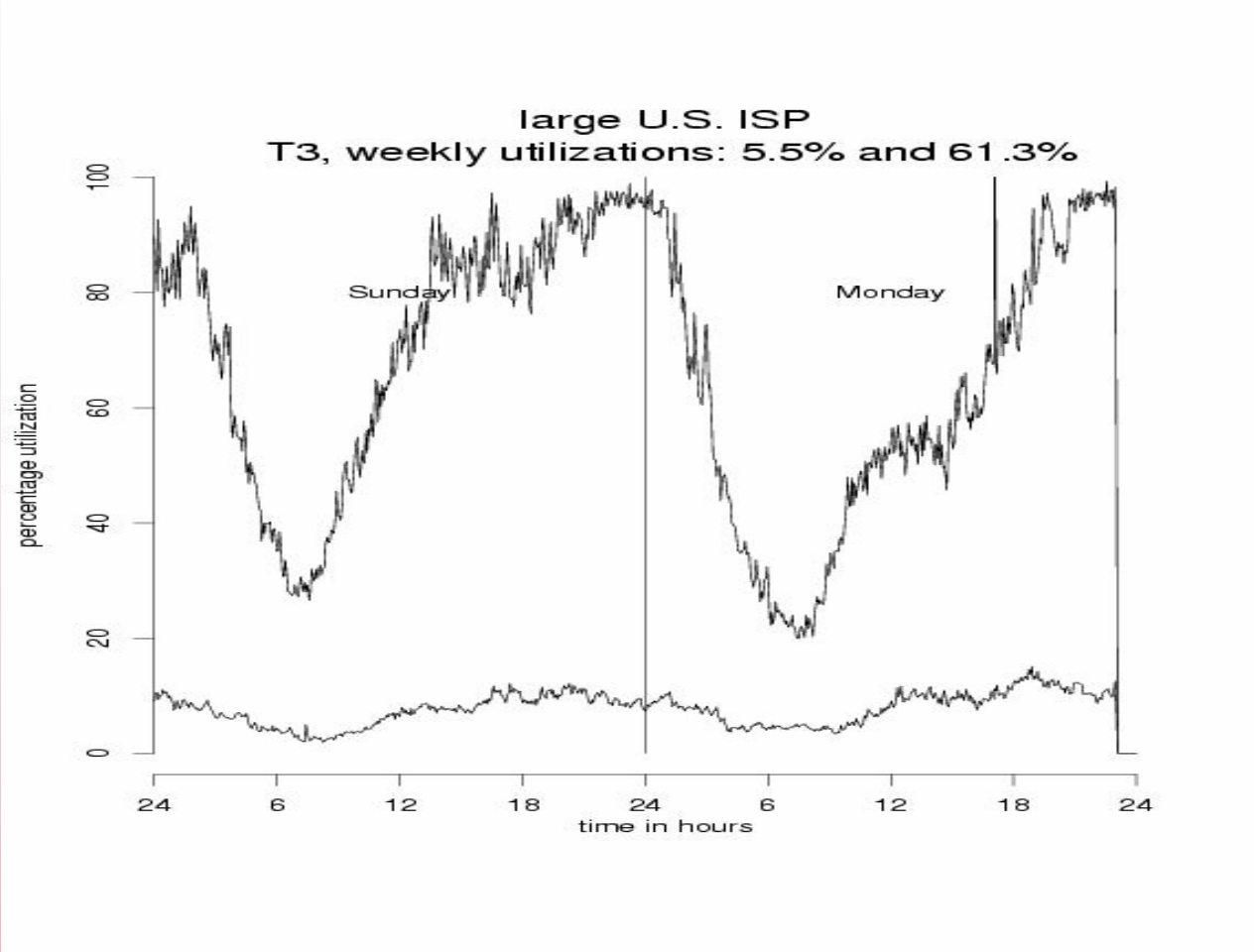
And (largely encompassing all of these): QoS

All technical successes, but failures in the marketplace

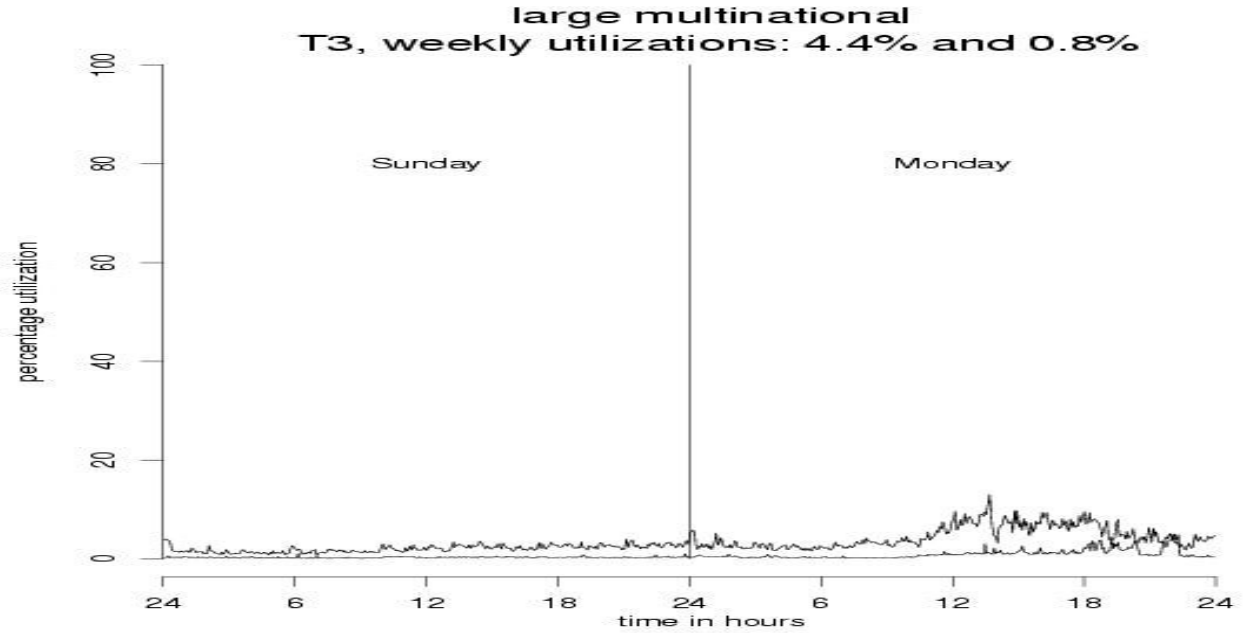
All recent "killer apps" created by users, not carriers:

- email
- World Wide Web
- browser
- search engines
- Napster

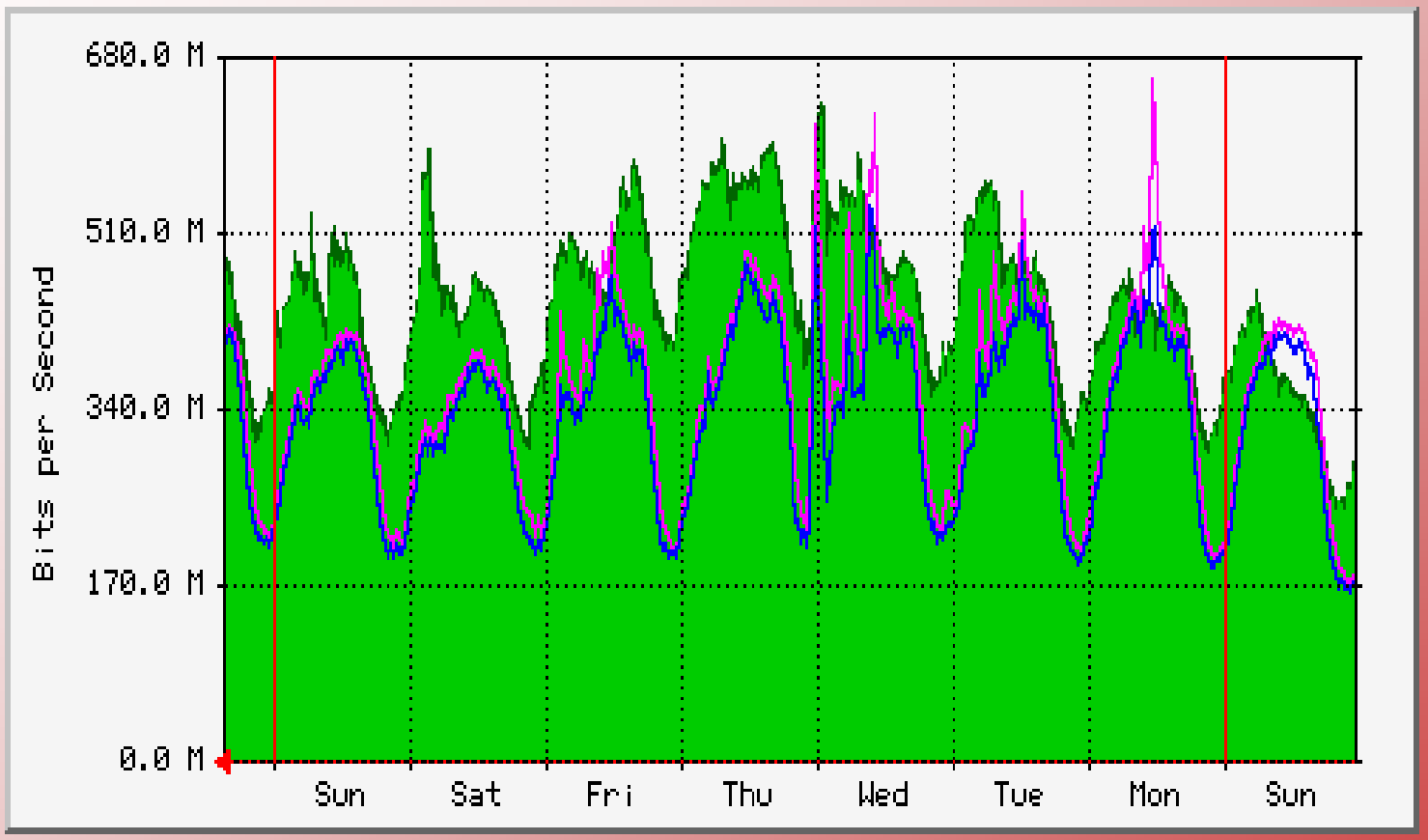
The dominant and seriously misleading view of data network utilization



Typical enterprise traffic profile: Demolishes myth of insatiable demand for bandwidth and many (implicit) assumptions about nature of traffic



Weekly traffic profile on an AboveNet OC192 link from Washington, DC to New York City



Streaming multimedia vs. file transfers:

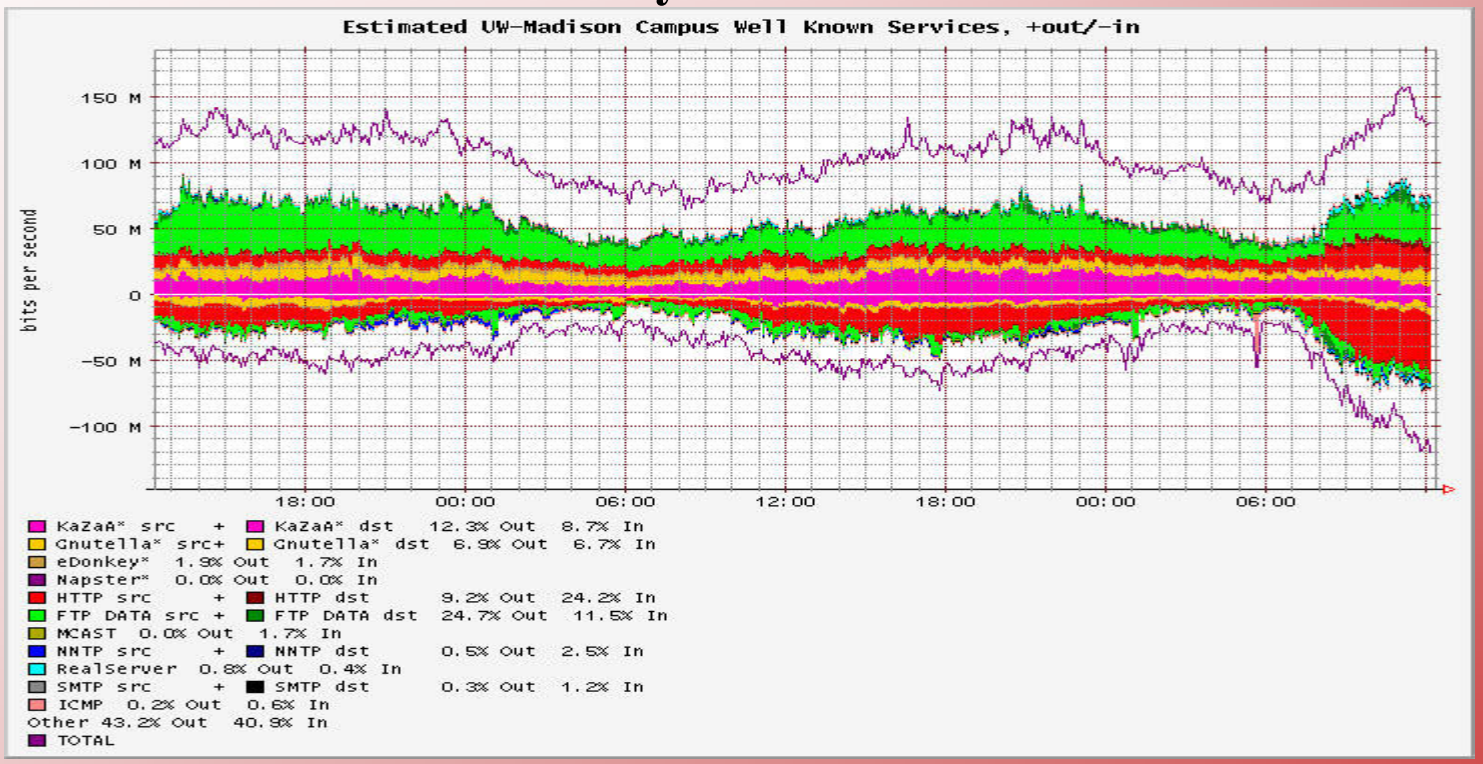
File transfer for local storage and transfer to other devices the most natural evolution (giving edge to Ethernet)

- **Predicted long ago**
- **Confirmed by Napster, . . .**
- **Want high bandwidth for faster-than-real-time**

We all have residential broadband (using conventional definition of broadband) courtesy of regular mail!

Multimedia file transfers a large fraction of current traffic, streaming traffic in the noise

Internet traffic at the University of Wisconsin in Madison



Conclusions:

- Broadband is advancing fast, although not at South Korean pace
- Spread of broadband impeded by
  - coping with massive overinvestment and malinvestment of the bubble years
  - several misleading myths

More data and speculations at www.dtc.umn.edu/~odlyzko