

Internet Past, Present and Future

by Gordon Bell

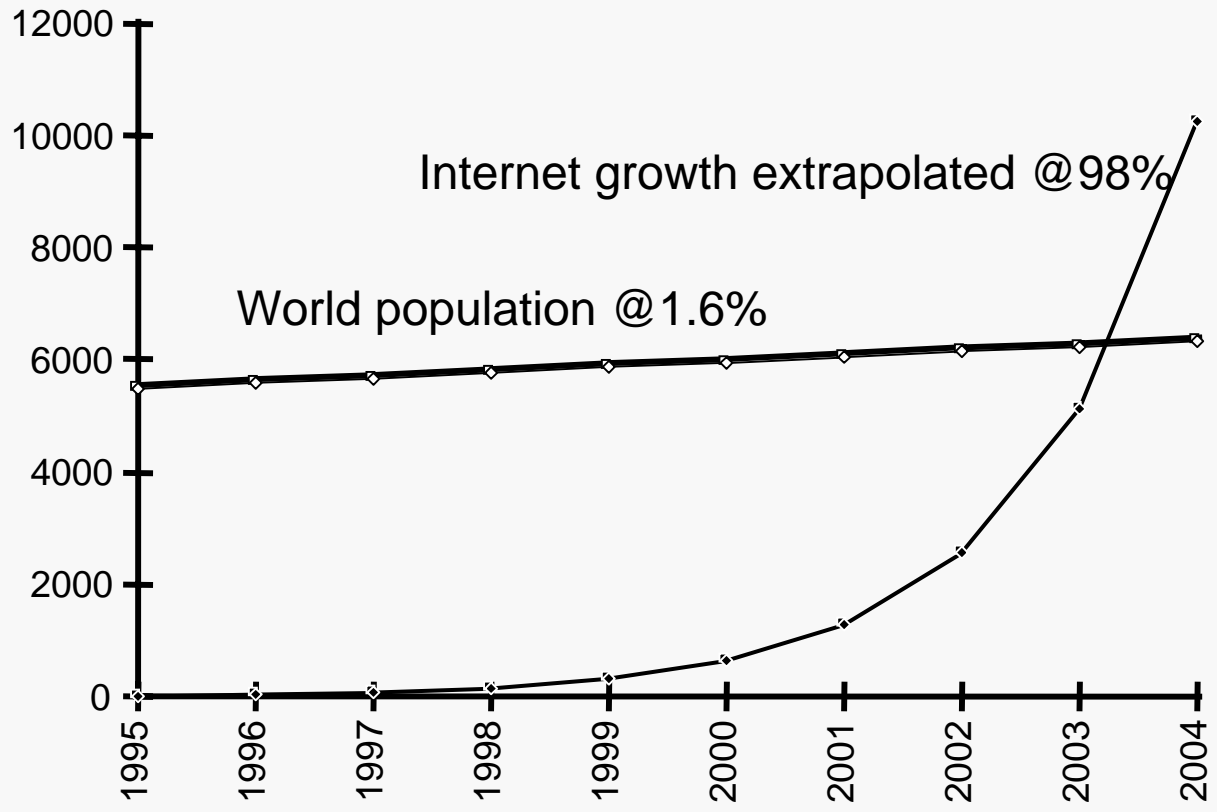
Yesterday, Today & Tomorrow
(Internet 1.0, 2.0, and 3.0)

Gordon Bell is a senior researcher in Microsoft's Telepresence Research Group - a part of the Bay Area Research Center (BARC) and a computer-consultant-at-large.

It's Bandwidth, Quality of Service, and Symmetry!

Or how the net takes over telephony and television...

Growth in users?



Internet Past, Present and Future

Why Internet will not collapse... any brownouts will help make it right

Three nets: research, public, and private Intranets

Bandwidth and capacity is available, its both money and some real technical problems

NO reason to fail... technical solutions exist to make it work successfully

Intranets won't fail: companies buy capacity

Government won't let it fail... it's too embarrassing

History: Story of Serendipity

Internet 1.0 aka ARPAnet goals:

rlogin; load, program, and
data sharing

Got:

rlogin,
mail, plus as a service carrier....
bbs/news/chat/muds/moos
ftp, and
rpc to enable network computing

Internet 2.0 (now)... *serendipity*

Internet 2.0 aka NREN aka NII aka GII goals:

provide high bandwidth for
access to supers & common facilities,
visualization, images and video

Got:

WWW, HTML, Gopher, and Mosaic.

Hyper-text links, mousing, slow graphics vrmf

Bill boards & catalogues to advertise

Bit warehouses for text, simple images, almost
telephony, & RealAudio™

CU SeeMe™ -- now they'll know you're a dog

Internet 3.0 goals & vision (IP dial tone)

single, high speed, universal dial tone for high speed,
symmetrical links that carry all bits

fungible bits: phone, videophone,
“radio” on demand, TV,
datacom with its own 2 & 3d video

bit serving warehouses for audio, images,
3D (x,y,t), and 4D (3D+z = VR)

tele-stuff: work, science, education, ... play

scalable & symmetrical (anyone can serve):

25 Mbps (not 0.01 -0.1)

cost of 2x telephones (telephone + cable)

replacement for telephony and cable!

Why Internet will grow... the price and functionality are right

Working, shopping, learning, playing, and info gathering are all working... the market is clear

- » Plain old services are faster, more convenient, and cheaper (e.g. FedEx[®])
- » It's faster to find info than going to a library, or finding the person or book who knows
- » Advertising is working (e.g. CNN[®]) and consumers are buying (e.g. L L Bean[®], United[®])

Free phone calls are being made...

undoing phone companies and eliminating PBXes

Phones evolve to videotelephony

Videotelephony evolves to television... VOD

The top six bottlenecks?

Within the home: Home NETS

»telephony: 128 Kbps (can carry 2 Mbps)

»television: coax (can carry 1 Gbps)

»data networks: 100 Mbps Ethernet

»control nets: 100 Kbps twisted pair

Home to the Central Office via the curb and neighborhood:
Cu pair, Cu coax, minimal fiber

Central Office to NAPs: fiber

Backbone and Internet infrastructure: fiber

Internet: IP and TCP have to be overhauled

Servers: too few, too slow

Eliminating the bottlenecks... revolutionizes telephony

Very high “Sunk” cost of copper and fiber:
holes in the ground, Copper, and fiber are paid for!

Fiber evolves 100x with wave division multiplexing;
10 Gbps/wave length =>1 Tbps

Deploy private networks for corporate Intranets

Many competing options for the local loop “last mile”:

- »Cu pair (telephony): can carry 10-20 Mbps vs 33Kbps
- »Cable TV fiber and Cu coax: carries n Gbps / 100
- »Fiber to the curb and home: will occur in time
- »Radio: LMDS and MMDS are possible for data

ATM NOW has a complete protocol suite to deliver
guaranteed bandwidth at low latency; applies to IP

Servers can be scaled... deploy more

Cache servers: help by eliminating network accesses

Final considerations

Internet today & tomorrow

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Telephony: time, distance and bandwidth cost model, but subscribers have paid for the “sunk” costs!

Data / television: always connected cost model

Internet traffic crosses over voice traffic in 2000

“Fixing” QoS (bandwidth & latency) implies ability to have very good audio and speech television

Telephony over Internet

- Distance independent pricing

- Eliminates the need (cost) for telephony billing (15% of costs)

- Eliminates PBX costs by having “telecomputer” for phone, videophone, and data access