There Is Plenty of Room at the Bottom !

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In remembrance of:

Doug Huber

PBS Video

Disclaimer

- My opinions!
- Like it or not!
- Caveat emptor!
- No direct operational value!

Beware of “expert opinions”

- "Unlike with other famous bubbles ... the Internet bubble is riding on rock-solid fundamentals, perhaps stronger than any the market has seen before. Underlying the crazy price increases are the foundations of what could become the early 21st century's leading growth companies.... Just because the Internet stock phenomenon looks like a bubble, it isn't a given that the bubble will burst.“

- Henry Blodget, Leading Internet Analyst, Oppenheimer Funds 3/5/2000
- March 10th, 2000 Nasdaq at 5,048

Nasdaq crashes !! Web is dead !!

- Surprised? Don't be!!!
- Open economies are cyclical
  - Kondratiev cycles
  - Market forces
    - Supply, demand, capital investment, employment, inflation, stability and productivity
- What is different?
  - Lengths and height of expansions
  - Lengths and depths of recession
    - Middle ages lasted 400 years
    - 1929 crash lasted a decade
    - Late 70's lasted 4 years
    - Early 90's a mere 2 years
    - 2001 recession* might not happen at all

How it all started!

- 1995 – Netscape goes public
  - Against very strong advice
  - IPO is wildly successful despite:
    - Never having made a penny
    - Having no idea when it would
    - Giving away most of it's products
- Why ?
  - Jim Clark needed to make a payment on a yacht or risk losing it!
- The rest is history…

How crazy was it, you ask?

- Pixelon raises $45M privately
  - Spends $27M in a launch party
  - Closed two months later
- Pets.com - Bag of dog food
  - Costs $15 and weights 55 pounds
  - Costs $29.80 to ship
  - Sock puppet was cute
  - Super Bowl commercial cost millions
- DEN.com – Sitcoms/series on the Web
  - Costs the same to produce
  - Requires big pipe
  - Requires large ad revenue

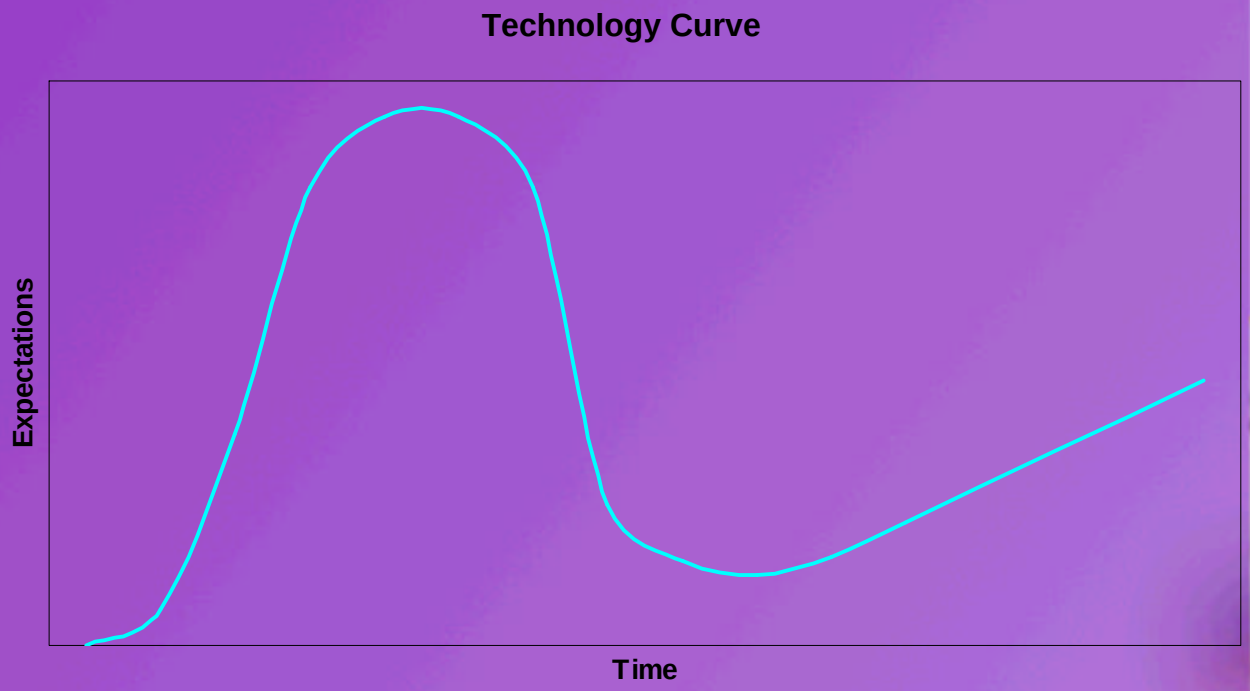
Why did it last so long?

- Basic premise is good
- Mob mentality of:
  - Traders
  - Investors
  - Public at large
- Rapid information:
    - Dissemination
    - Analysis
    - Reaction
- Stewed in it’s own juices of technological evolution

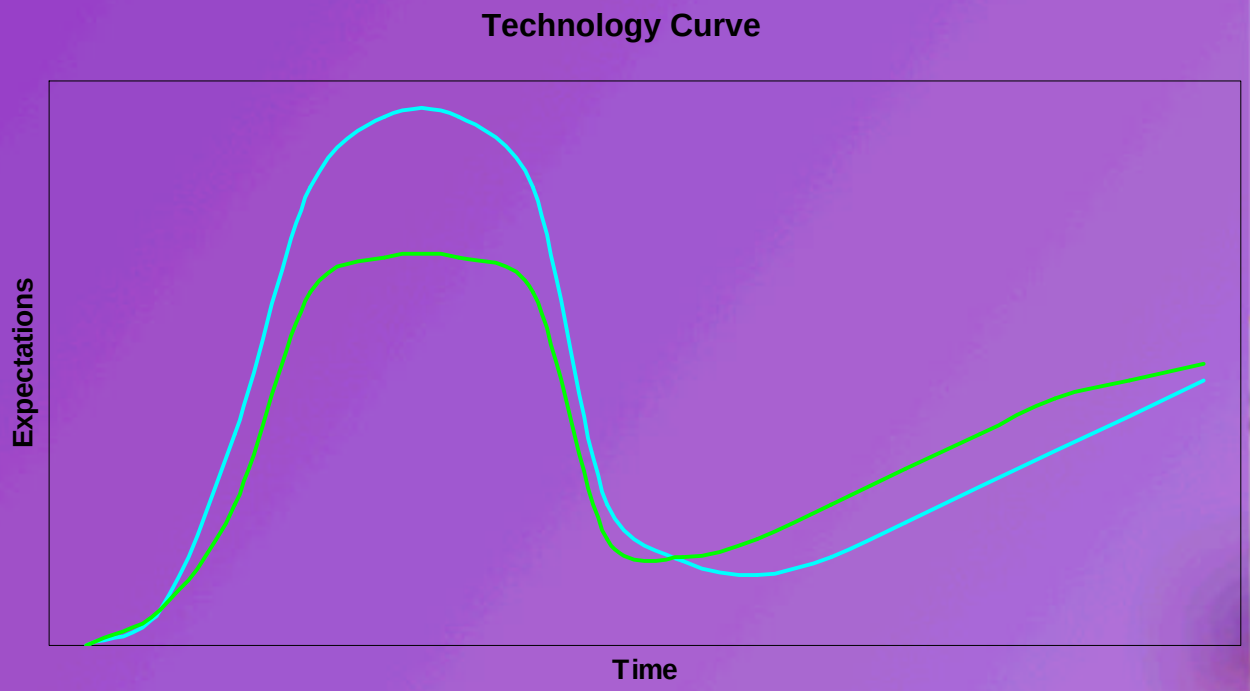
Dynamics of Technological Evolution

- Technology curve
- Short term overestimation
- Long term underestimation
- Inevitability
  - If it can happen….
  - It will happen!

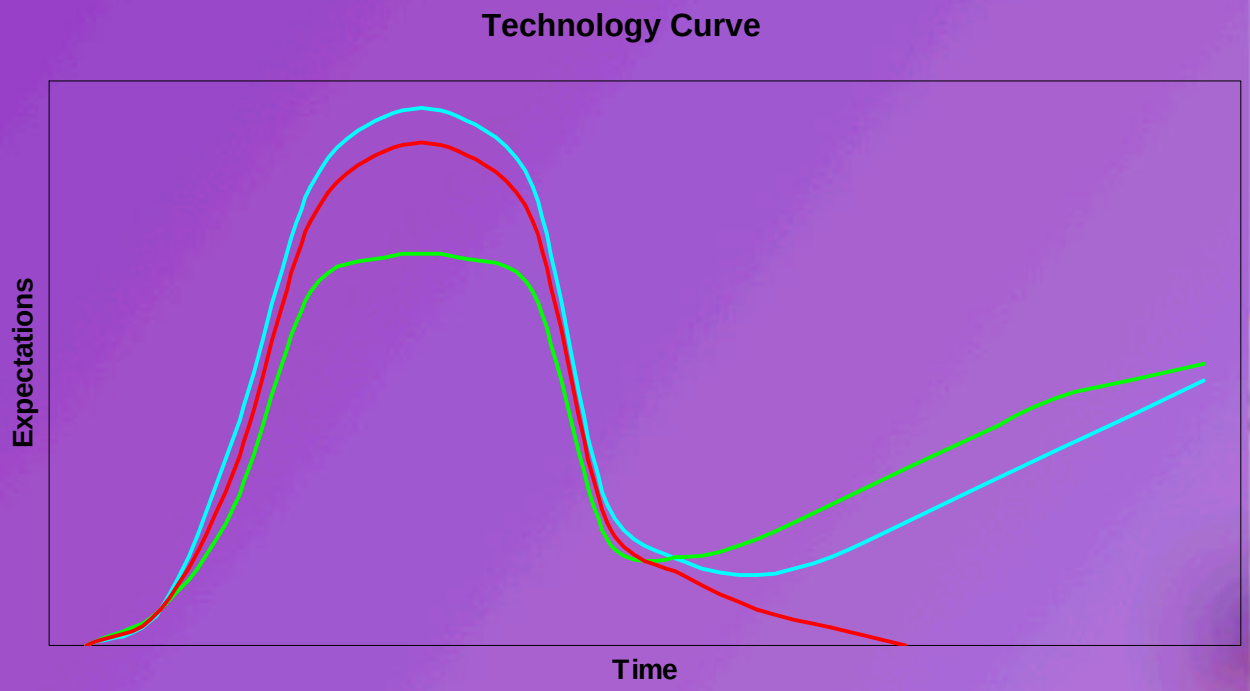
Technology Curve



Technology Curve



Technology Curve



Technology Curve - Red Hat

Period : Apr-10-1998 - Apr-10-2001

Technology Curve - Priceline

Period : Apr-10-1998 - Apr-10-2001

Technology Curve - MicroStrategy

Period : Apr-10-1998 - Apr-10-2001

Short Term Overestimation

- We tend to overestimate the impact of new technologies over a 2 year time span
  - Web retail expectations
  - Broadband penetration
  - ASP model
  - WAP/Wireless adoption
  - Speech recognition
  - Wearable computing

Long Term Underestimation

- We tend to substantially underestimate the impact of technological changes over the long haul (10+ years)
  - Personal computer
  - Internet
  - Biotechnology
  - Pervasive computing

If it can happen…it will happen!

- Is it physically possible ?
- Does it fulfill a basic human need/want?
- Is there money to be made from it?
- It will happen…. faster & faster

- "It will take over 100 years before we decode the entire human genome" *Bottstein, MIT 1975*

- "It will take us another 3 or 4 decades before we finish the whole thing" *Ridley, CIT & MIT 1992*

- "Done" *J. CraigVenter, Celerra Genomics & Francis Collins, Human Genome Project June 2000*

“There is plenty of room at the bottom!”

Richard Feinman

12/12/59

There's plenty of room at the bottom!

- The next several waves of technological evolution are hitting the shore
- They are being driven by the marriage of Information Technology and:
  - Physical Sciences:
    - Optics
    - Micro
    - Nano
  - Life Sciences
    - Genomics
    - Proteomics
    - Medicine

Physical Sciences

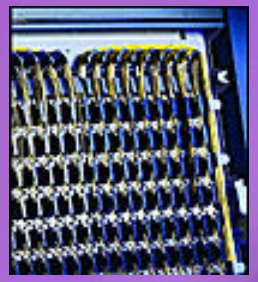
- Optics
- Micro Engineering
- Nanotechnology

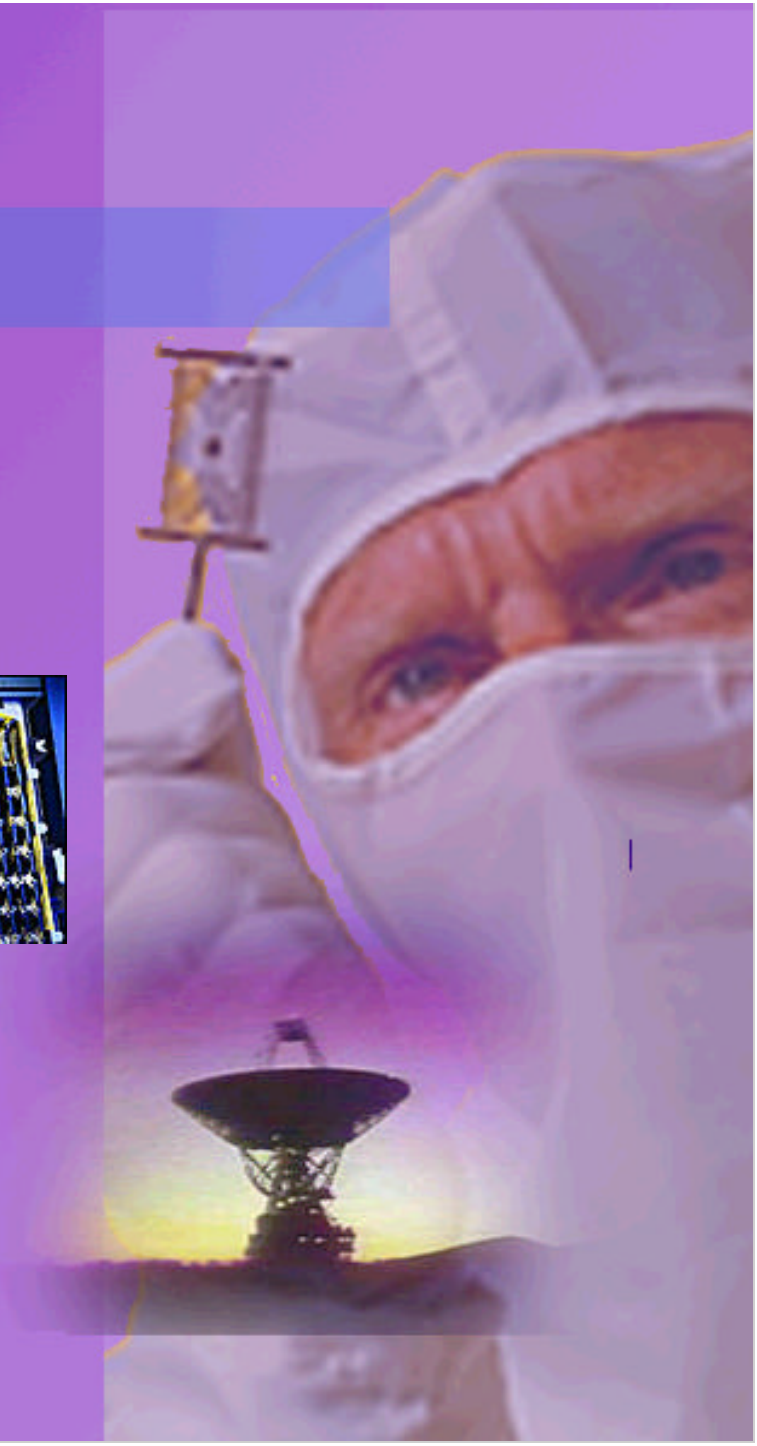
Optics – Let there be light….

- DWDM live & carrying data
- Siemens/WorldCom (3/13)
  - Dallas area live system
  - 3.2 Tb/s for a whole month trial
- Alcatel – 10.2 Tb/s (3/22)
  - 256 Wavelengths @ 40 Gb/s
  - 100 Km (62.5 miles)
- NEC – 10.9 Tb/s (3/22)
  - 273 wavelengths @ 40 Gb/s
  - 117 Km (73.125 miles)
- 150 million simultaneous calls

Now that's a fire hose!

- Optical Switching
- Ciena
  - Multiwave Core Director (MCD)
    - 640 Gb/s per bay
    - Granular to STS-1
- Corvis
  - Optical Switch (OS)
    - 2.4 Tb/s
    - 3200 Km (2000 miles)



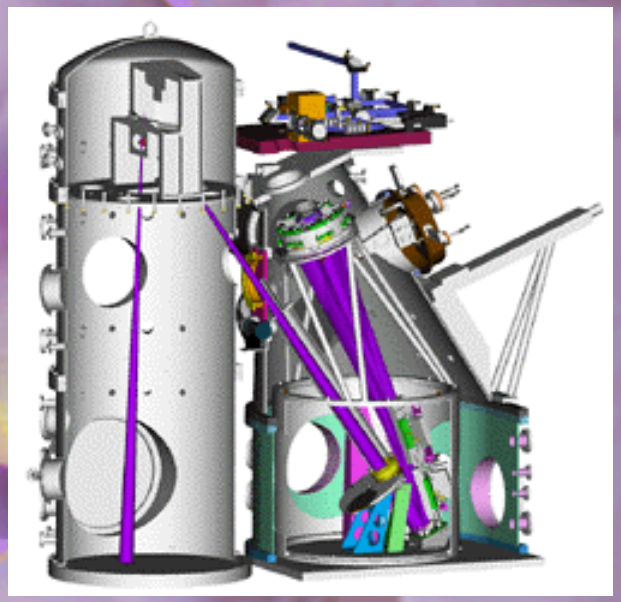


Fiber to the door (of your bathroom?)

- CityNet raises $275M in funding
  - Sewer robots bring fiber to buildings
  - No need to tear up the streets
  - 95% of households have sewer system
  - Projects in:
    - Omaha, NE
    - Albuquerque, NM
    - Indianapolis, IN
  - Negotiating with 28 other cities
- New homes built with fiber ports

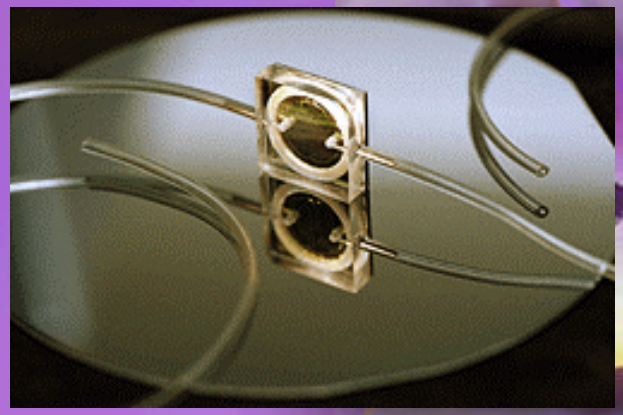
Micro Engineering

- EUV Lithography announced 4/11/01
- Partnership in late 1997
  - Intel, AMD, Motorola, IBM
  - Gov. labs (sandia, Berkeley, Livermore
- Current microprocessor circuits are lithographed onto chips
  - Intel Pentium 4 – 1.5 GHZ (.18 Micron)
  - Lithography expected limit (.1)
  - 1/1000 of width of human hair
- Extreme Ultraviolet Lithography
  - EUV expected limit (.03)
  - 10 GHz by 2005-2006
  - 10 Gigabyte memory chips



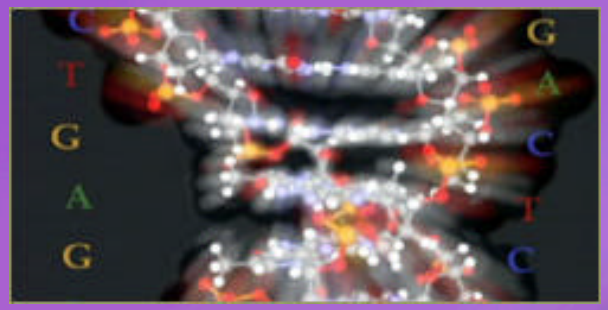
Nanotechnology – Size does matter!

- Computer evolution:
  - Electronic gates etched on silicon
  - Carbyne molecular switches
  - Quantum mechanical effects
- Tool evolution
  - Hacksaw
  - Scalpel
  - Smart scalpel
  - Intra-cell computers



Life Sciences – Unraveling life

- Genomics
- Proteomics
- Medicine



Genomics – The fun has just begun

- Human Genome
  - Mendel to Watson/Crick in 100 years
  - Watson/Crick to genome 40 years
  - First draft completed June 2000
  - About 32,000 genes
- Potential uses
  - Personalized medicine/lifestyle
    - Genetic propensities/deficiencies
    - Allergies
  - DNA Chips will detect personal variations
    - P-glycoprotein and chemoterapy
  - Pre-Implantation Diagnosis
    - Jack and Lisa Nash and Fanconi's anemia

Genomics – Telomeres/Telomerase

- Sets of TTAGGG sequences at ends of chromosomes
- As cell divides they wear off
- When they are done, cells stop dividing
- These cells show altered gene expressions
- Possibly giving rise to chronic degeneration
- Enzyme Telomerase can restore telomeres
- Telomerase can immortalize a cell
- Need I say more…..

Proteomics - Simple to mind bogling

- Protein therapeutic agents
  - Erythropoetin – Over $3B/year
    - Single protein treatment for anemia
  - Recombinant Factor IX
    - Type B hemophilia treatment through gene therapy
- Protein to Protein interactions
  - Key to more intricate systems
  - Complex feedback cycles
  - Huge computational requirements
  - $13x10^{21}$ FPO to fold a single protein

Medicine – Pluripotent Stem Cells

- Primitive, self-renewing cells that can develop into all cells and tissues in the body
- Express Telomerase at high constant level in their undifferentiated stage
- Originally harvested from embrionic tissue
- Recently harvested from fat cells
- Differentiation can be precipitated by different enzymatic combinations
- Tissue regeneration
- Eventually:
  - Limb and organ regrowth
  - CNS function regeneration

Medicine - Life extension

- Dr. Francis Collins (HGP):
  - 2020 gene base designer drugs
  - 2030 all ageing genes catalogued
  - Routine personal genomic sequence
  - Taking charge of human evolution
- Consider this:
  - Today 135 days every year
  - In 10 years we could double that
  - Then what?
  - 77 + (135*29/365) = 88
  - 39+29 = 68

Will it happen ?

- Is it physically possible ?
- Does it fulfill a basic human need/want?
- Is there money to be made from it?
- It will happen…. faster & faster

Should it happen?

- Genetic diagnosis with no cure
- Human cloning
- Human genetic engineering
- Immortality
- “The human race will rapidly evolve in the near future. It may not be in accord with democratic and egalitarian principles, but then again Darwinian evolution has never been politically correct”

Stephen Hawking Ph.D.

In summary:

- For the foreseeable future, technological evolution combined with scientific advances will create an environment propitious to massive societal change where many basic tenets of our culture will be tested, questioned and possibly eliminated

IT is at the crux of this evolution

- All science is computer science
  - Physics modeling
  - Mathematical simulations
  - Biotechnology research
    - From *in vivo* to
    - *in vitro* to
    - *in silico*
- All business is IT driven
- Good IT will make and/or break companies

IT within Public Broadcasting

- Effectively, and for each entity in the Public Broadcasting universe, the soundness of technological decisions and deployments will spell the difference between extinction and survival, mediocrity and success.

What is our challenge then?

- Energize ourselves with the fundamental nature of our role within our station
- Share that vision with our staff
- Sell that vision to our management
- Aim to the highest goals…
- And we shall achieve them!

Because remember….

There is plenty of room at the top too!

Questions?