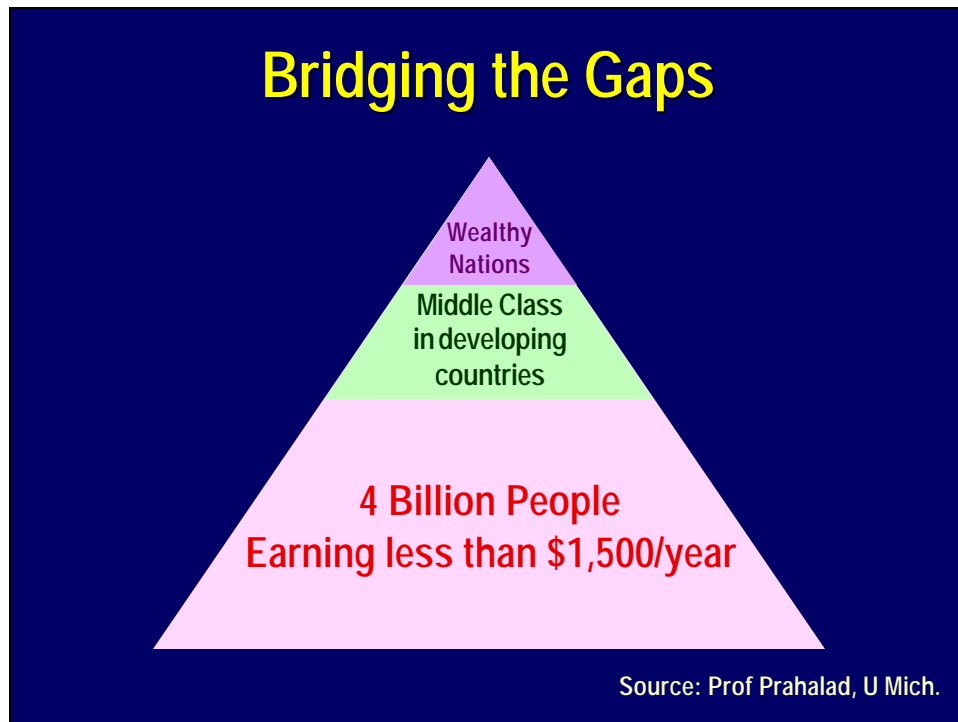




## Presentation Outline

- ✍ Societal-Scale Grand Challenges
- ✍ The Key: **Disruptive 'Business Models'**
- ✍ **CITRIS**: The Center for Information  
Technology Research in the Interest of  
Society
- ✍ Research Examples



## Bridging the Gaps

**We are Living in a Global Economy and a  
Global Society**

**We Depend Upon One Another—All of Us  
and so we must**

-  **Empower Poor People Throughout the World**
-  **Celebrate & Reconcile Our Many Differences**

**“Local Globalization”**

Source: Prof Prahalad, U Mich.

## Info-Bio Technology Research and Societal Grand Challenge Problems

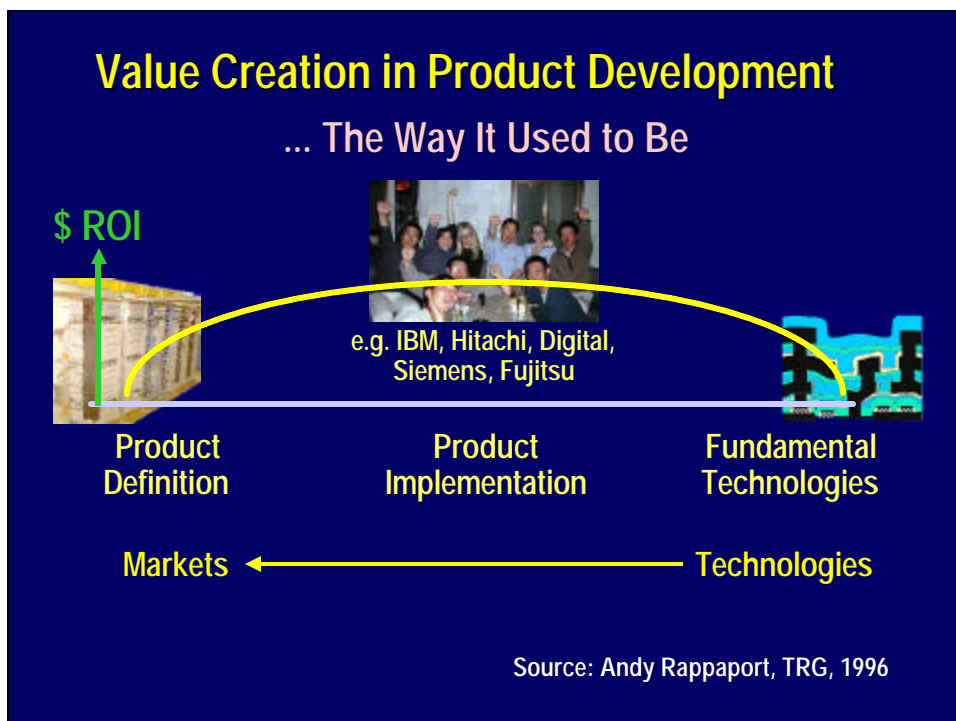
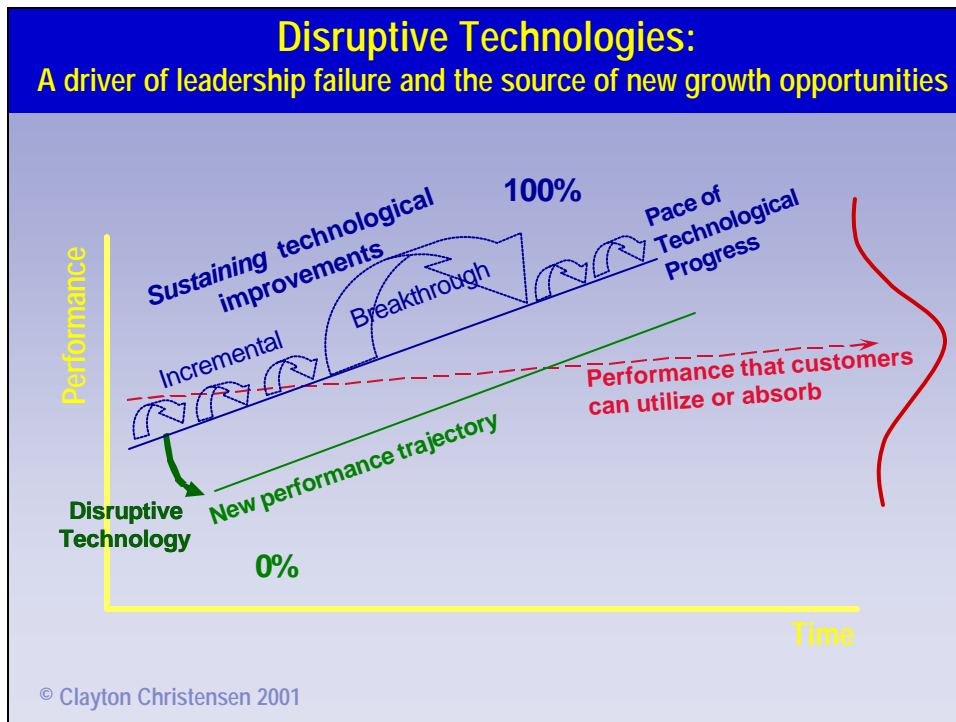
- ✦ Within the next decade, we will develop a sustainable business model and associated collection of system architectures and component technologies for providing affordable and useful digital services to the four billion people on earth earning less than \$1,500/year.
- ✦ Within the next decade, we will develop and deploy sustainable and affordable technology that will guarantee reliable access to clean drinking water for over 90% of the people and animals on earth.
- ✦ Within the next decade, we will develop and deploy monitoring and control systems that can reduce both commercial and domestic energy waste by over 90%.
- ✦ Within the next half century, we will develop and deploy appropriate sustainable, affordable and reliable energy sources for use by all people throughout the world.

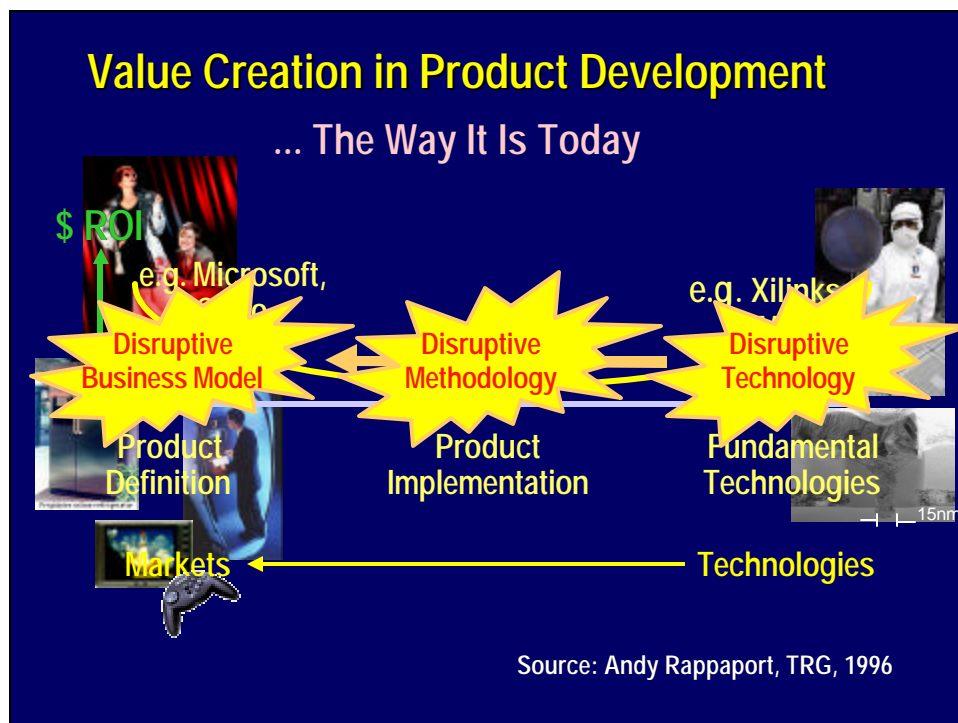
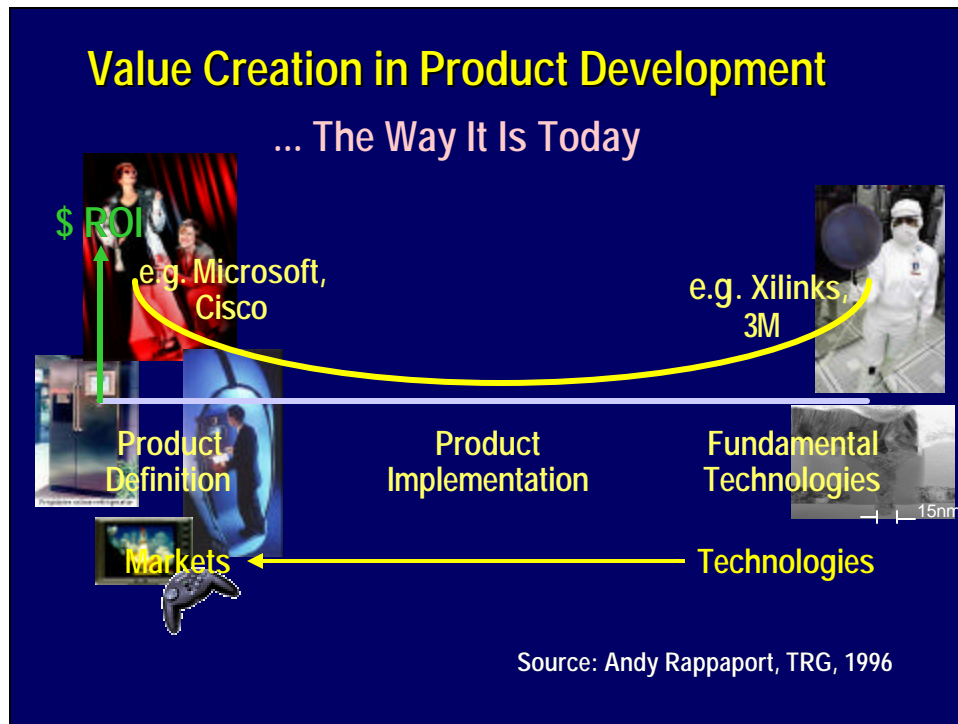
Developed by Tom Kalil & Richard Newton

## Info-Bio Technology Research and Societal Grand Challenge Problems

- ✦ Within the next fifteen years, we will improve the average literacy levels in the world by 5 grade-years by making compelling, culturally-relevant, cost-effective and robust digital tutor technology available to any interested group on this planet.
- ✦ Within the next decade, we will reduce the unemployment rate of people with disabilities by 50% throughout the world.
- ✦ Within the next decade, we will increase the average duration of time by which an elderly person can live comfortably at home by at least five years.
- ✦ Within the next decade, we will provide affordable access to all known authored works on line. This will include all contemporary and historical documents, works of art, film, and recorded performances.

Developed by Tom Kalil & Richard Newton





## Grameen Phone

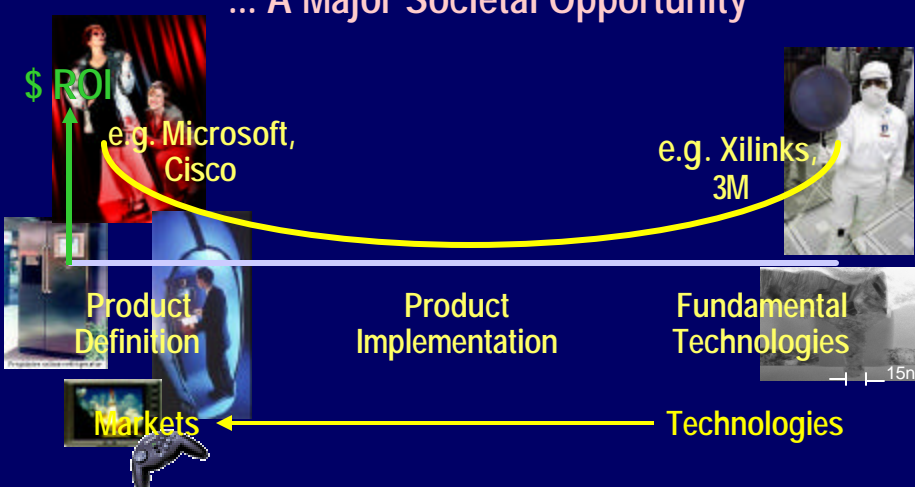
### A Disruptive Societal-Scale Business Model



- ✍ 'Village Phone' is a unique idea that provides modern telecommunication services to the poor people of Bangladesh.
- ✍ The goal is to provide telecommunication services to the 100 million rural inhabitants in the 68,000 villages in Bangladesh—the largest wireless pay phone project in the World.

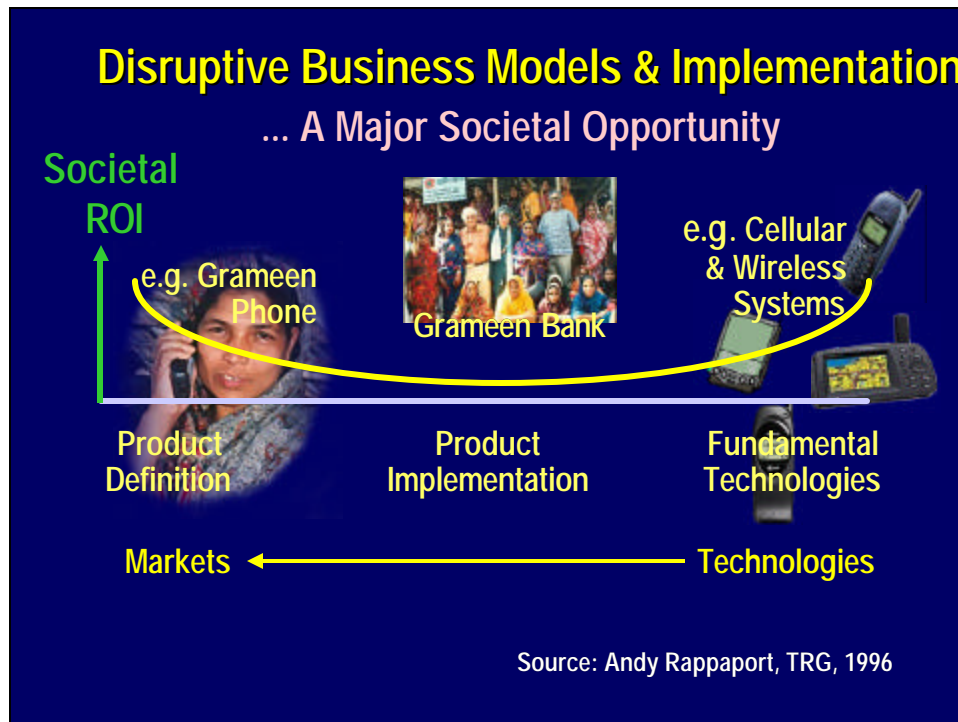
## Disruptive Business Models & Implementation

### ... A Major Societal Opportunity



The diagram illustrates a process flow from **Fundamental Technologies** (e.g., Xilinx, 3M) through **Product Implementation** to **Product Definition** (e.g., Microsoft, Cisco), which then leads to **Markets** and **ROI**. A yellow arrow curves from the top right towards the top left, indicating a transition or flow. A blue arrow points from **Technologies** to **Markets**. A green arrow points upwards from **Product Definition** to **ROI**. A scale bar of 15nm is shown near the **Fundamental Technologies** section.

Source: Andy Rappaport, TRG, 1996

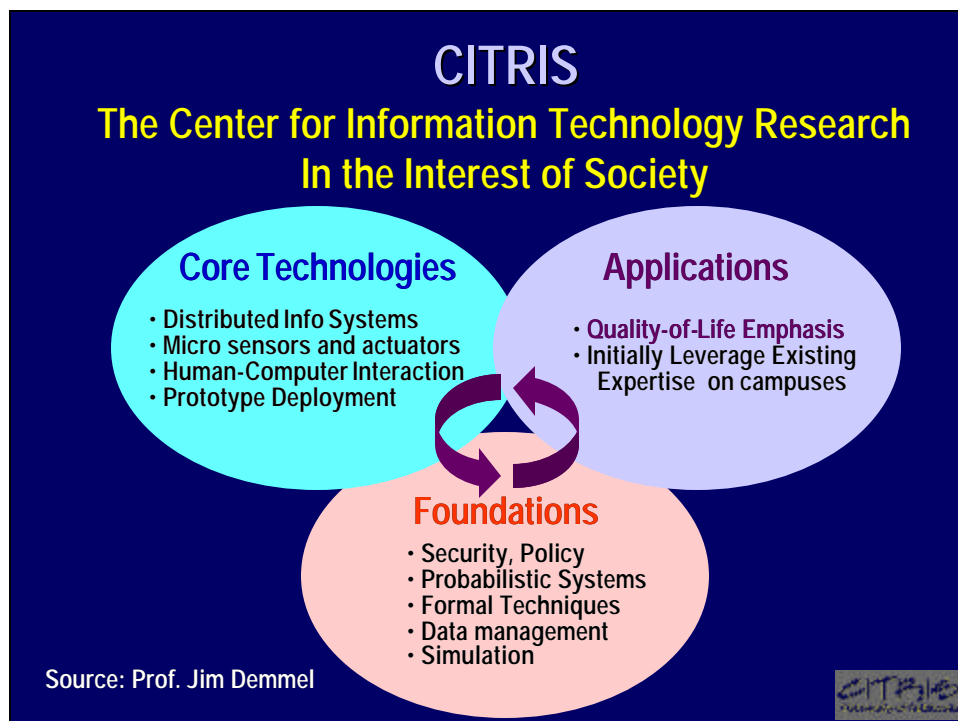


## Are There Ways to Profitably Serve These 4 Billion Citizens?

- ✍ Keys to the future:
  - ✍ New Technology (e.g. societal-scale information systems, global and open communications systems, ultra low-cost electronics)
  - ✍ New Business Models (e.g. Grameen Phone project)
- ✍ "Triple Bottom Line"
  - ✍ Financial ROI
  - ✍ Environmental ROI
  - ✍ Societal ROI

## Presentation Outline

- ✍ Societal-Scale Grand Challenges
- ✍ The Key: Disruptive 'Business Models'
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- ✍ Research Examples






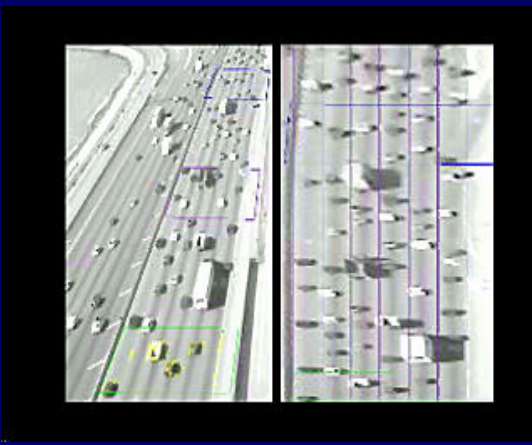
## The Best Technology for The World's Biggest Challenges

- ✍ Energy Efficiency
- ✍ Transportation Planning
- ✍ Monitoring Health Care




## The Berkeley Highway Lab

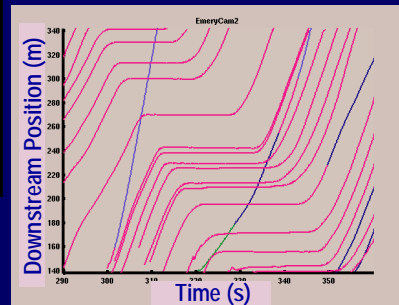
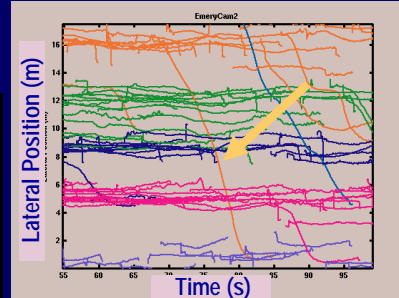
- ✍ Twelve cameras with overlapping fields of view covering 1.5 miles of Interstate 880
- ✍ Video data are processed to obtain position and speed of every vehicle



Source: Prof. Pravin Varaiya



## Lane-Changing Maneuver and Shockwave



Source: Prof. Pravin Varaiya

## The Best Technology for The World's Biggest Challenges

- ✍ Energy Efficiency
- ✍ Transportation Planning
- ✍ Monitoring Health Care



CITRIS  
University of California, Berkeley

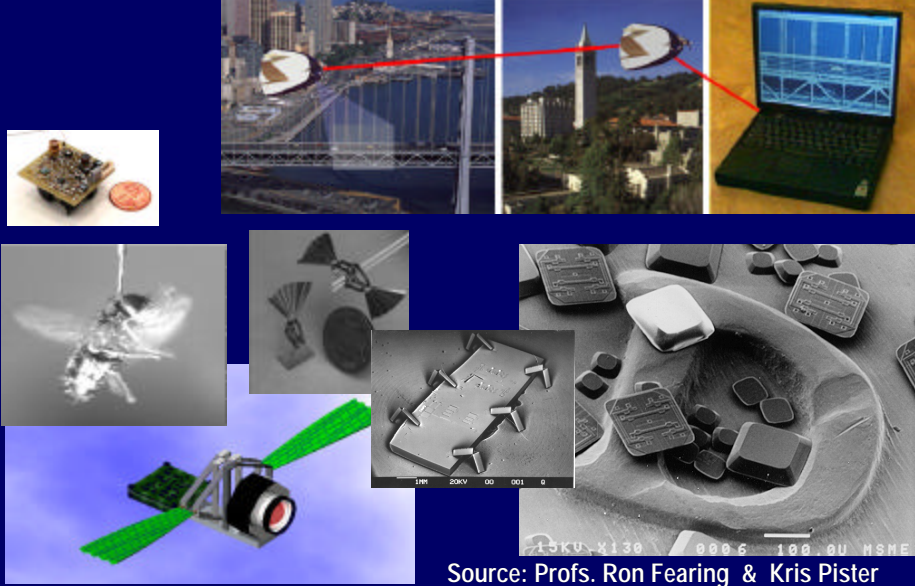
## Wireless Measurement, Diagnosis, and Cure

Source: Profs. Jan Rabaey, David Culler, Al Pisano, and Kris Pister

## The Best Technology for The World's Biggest Challenges

- ✍ Education
- ✍ Emergency Response
- ✍ Land and Environment

### Microair Vehicles and Smart Dust: Connecting the Civil and Environmental Infrastructure



Source: Profs. Ron Fearing & Kris Pister

### Distributed, Wireless Sensor Networks A Revolution for Civil Infrastructure & Society



Source: Prof. Steve Glaser

### Seismic Monitoring of Housing by Wireless Sensor Motes



\$8,000 each

Source: Prof. Steve Glaser

### Seismic Monitoring of Housing by Wireless Sensor Motes



\$70 each

Source: Prof. Steve Glaser



## eMerging Societal-Scale Systems

Scalable, Reliable,  
Secure Services

Information Appliances

"Server"

"Client"

MEMS

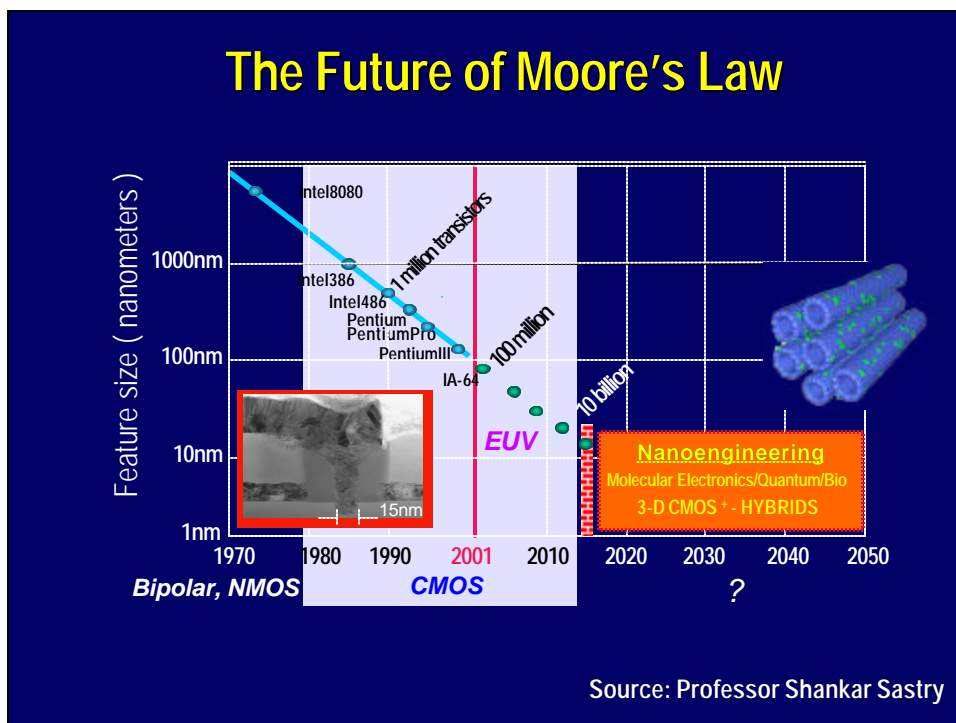
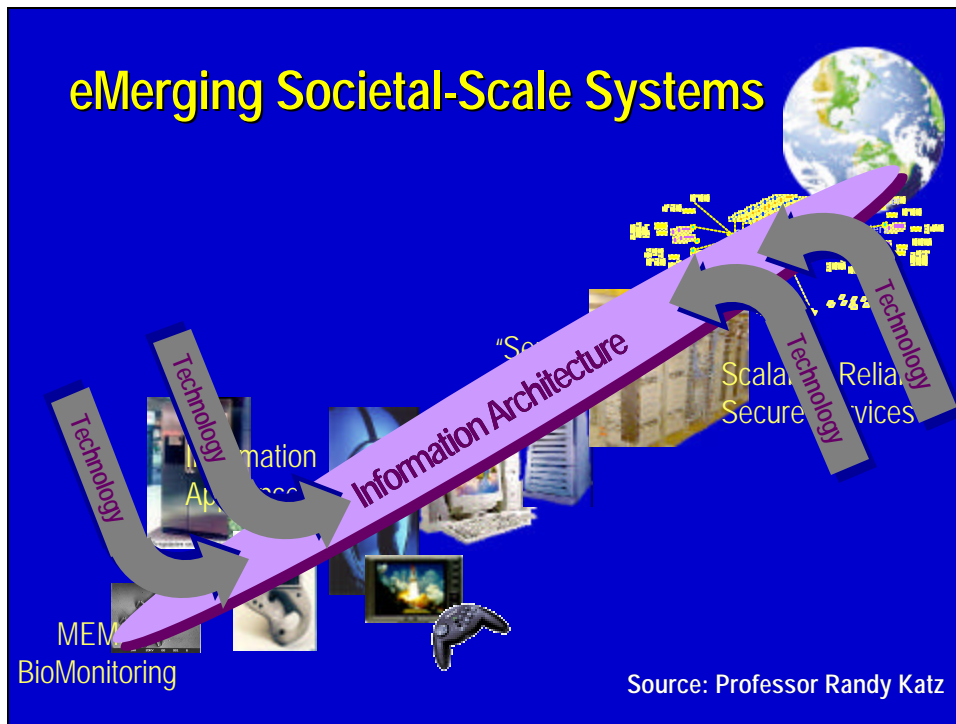
BioMonitoring

Source: Professor Randy Katz

## Implementation & Deployment of an Oceanic Data Information Utility

- ✍ Ubiquitous devices require ubiquitous storage
- ✍ 10,000 9Gbyte IBM Microdrives in a single rack provides 90terabytes/m<sup>2</sup> (Professors Dave Patterson & Kathy Yellick)
- ✍ Confederations of (Mutually Suspicious) Utilities

Source: Professor John Kubiawicz

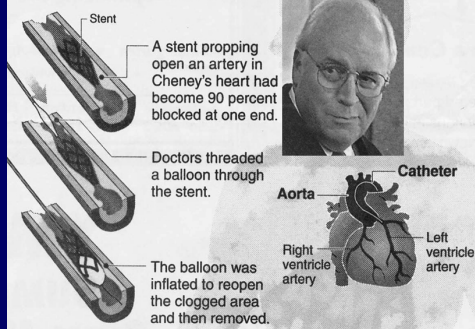




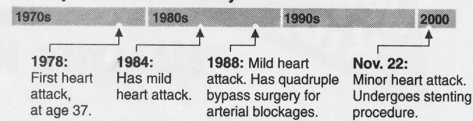
## BioNanoEngineering & Human Health

### Cheney's heart condition

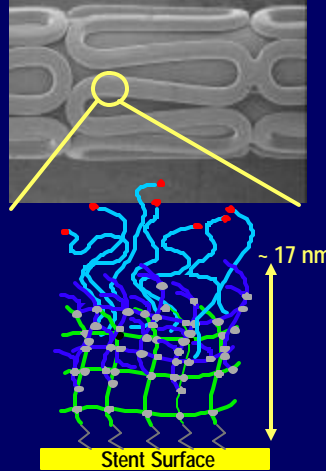
Doctors performed angioplasty on Vice President Dick Cheney to reopen a mesh support, or stent, placed in an artery in November. The stent had narrowed at one end.



### Cheney's heart attack history

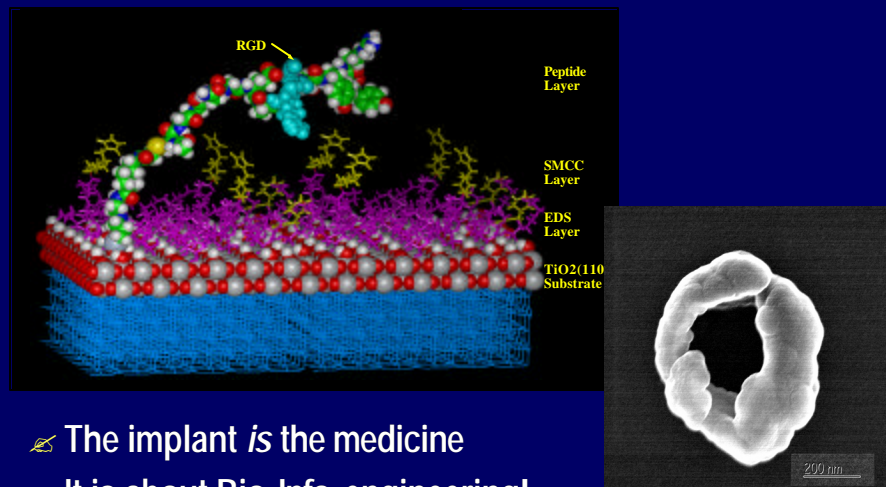


### Unexpanded GFX Stent (AVE-Medtronic)



Source: Professor Kevin Healy

## Biocomputation & Biomimetic Materials



- ✍ The implant *is* the medicine
- ✍ It is about Bio-Info-engineering!

Source: Professor Kevin Healy

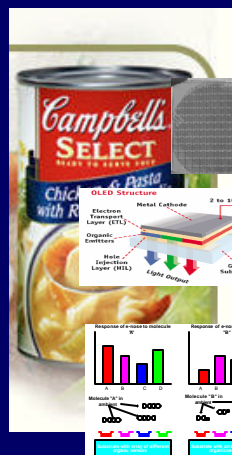
## Is the End of Moore's Law an Economic One?

- ✍ Silicon is not suited for low-end human-centric consumer appliances
  - ✍ Baseline costs of traditional chips are high
  - ✍ Cannot easily integrate human interaction component
- ✍ The solution: Organic Semiconductors
  - ✍ "Spray on circuits" – no clean rooms
  - ✍ Easy to integrate display, computation and sensing



Source: Professor Vivek Subramanian

## "Smart Soup"



**Electronic "Bar Code"**  
Passive RF circuit that talk to the outside world... no need for scanners



**Real-time Labeling**  
Develop new generations of reflective display technology for ultra-low power "electronic paper" displays No more incorrect pricing!



**Closed Loop Content Monitoring**  
No more expiration dates... the can knows when it has expired!

Source: Professor Vivek Subramanian

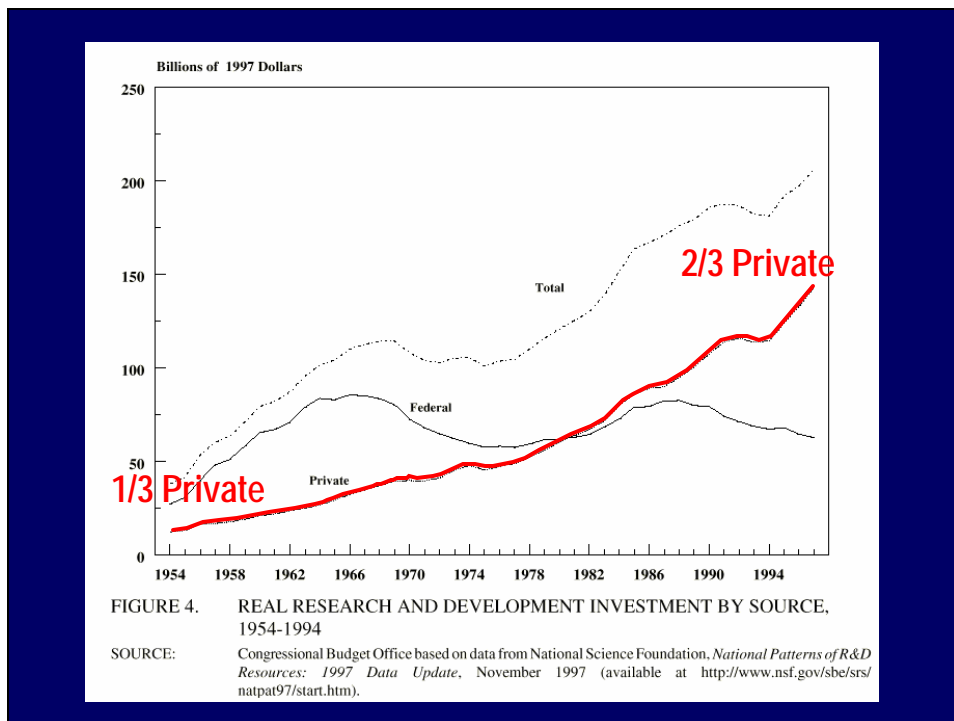


## Gecko Adhesive

- Sticks to wet or dry surfaces
- Sticks to rough or smooth surfaces (e.g. concrete or glass)
- Self cleaning
- Leaves no residue
- Reusable
- Can be turned on/off at 10 Hz
- Pull-off 10N/cm<sup>2</sup>

**Goal: artificial nanofabricated structures with gecko adhesive performance**

Source: Professor Ron Fearing



## CITRIS is a Partnership with Industry

*"I believe we are now entering the Renaissance phase of the Information Age, where creativity and ideas are the new currency, and invention is a primary virtue, where **technology truly has the power to transform lives, not just businesses, where technology can help us solve fundamental problems.**"*

Carly Fiorina, CEO, Hewlett Packard Corporation

### Founding Corporate Members of CITRIS



Future Opportunities and the Challenges Lie at  
the Boundaries Between Technology and  
Global Society

We Must Focus Our Attention on  
Societal-Scale Systems that Will Build Bridges  
Between People Throughout the World



