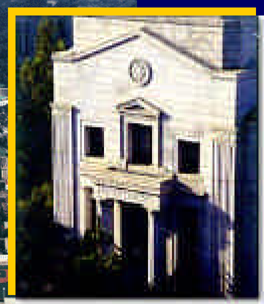
Laying the Foundations for the Next Digital Revolution:

Innovation in the College of Engineering at Berkeley



5th Asian Leadership Conference
Shanghai, China

Dean A. Richard Newton

Berkeley
university of california

The Weather Forecast ...

- Rate of change will only accelerate - life will be more complex, busier . . .
- Adaptability, agility & momentum will be the key to success!
- Innovation, opportunities & entrepreneurship will thrive
- Disruption will be the order of the day
- Fun, fortunes & failure will be in abundance

Source: Vinod Khosla, Kleiner Perkins

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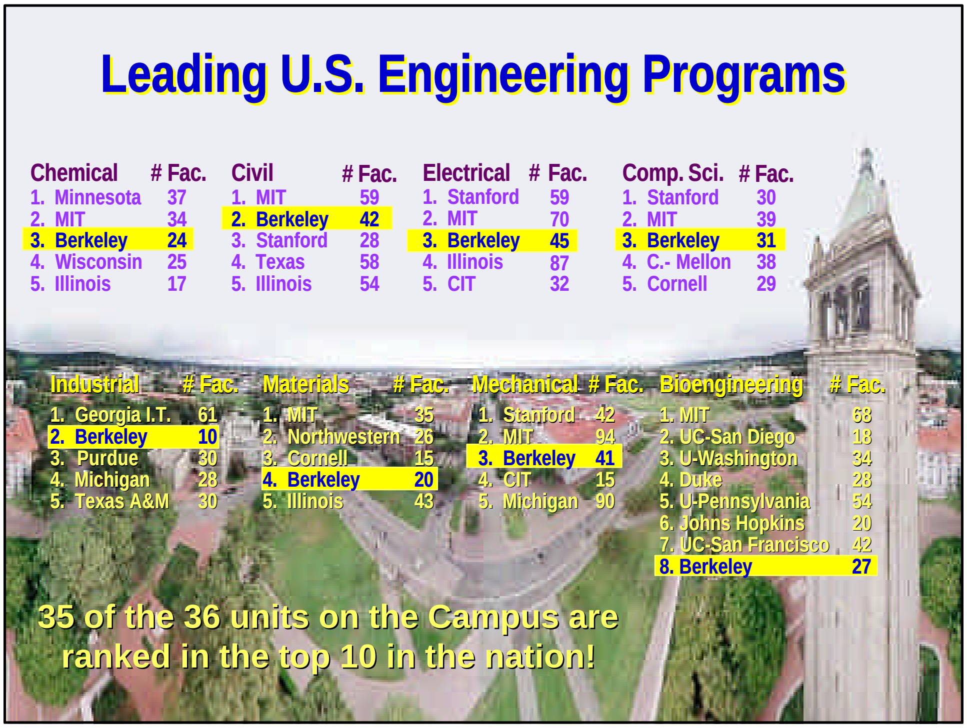

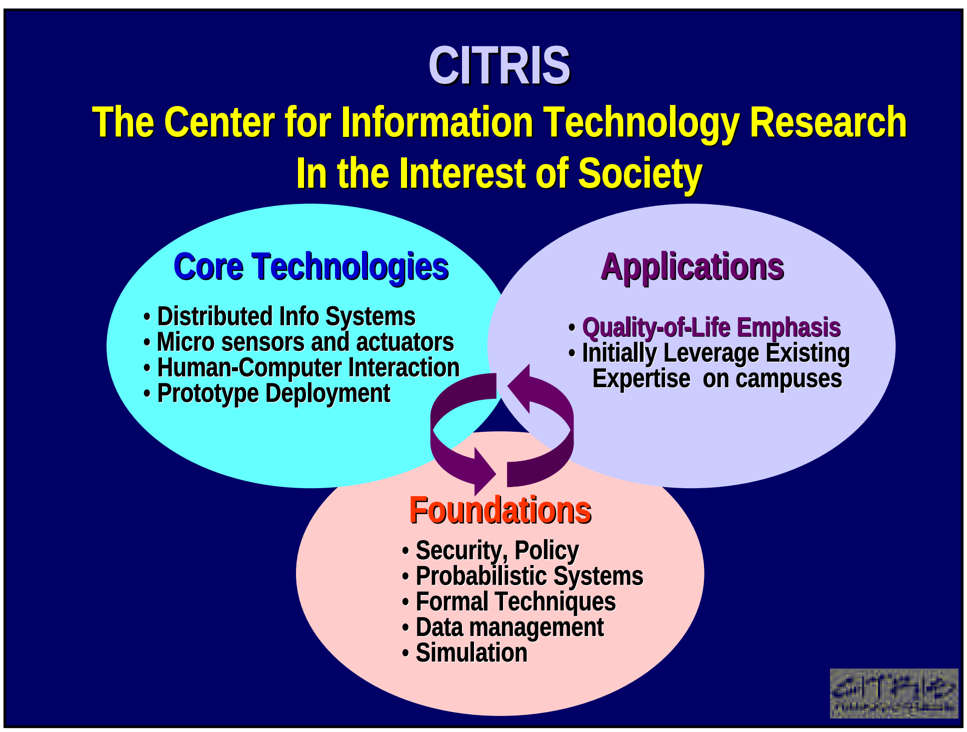

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The Best Technology for The World's Biggest Challenges

- 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

Freeway Performance Measurement Project

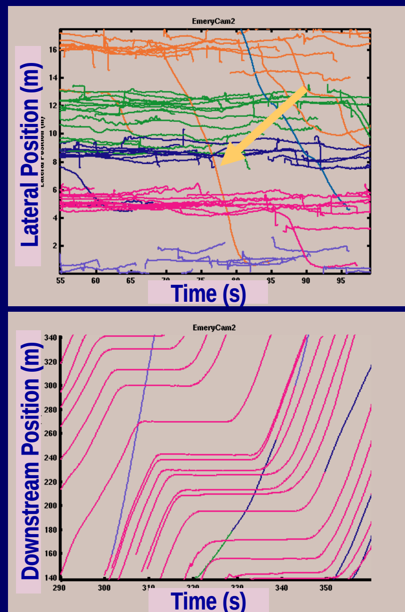
PATH Partners for Advanced Transit and Highways

Caltrans

Source: Prof. Pravin Varaiya

CITRIS University of California

Lane-Changing Maneuver and Shockwave



Source: Prof. Pravin Varaiya

The Best Technology for The World's Biggest Challenges

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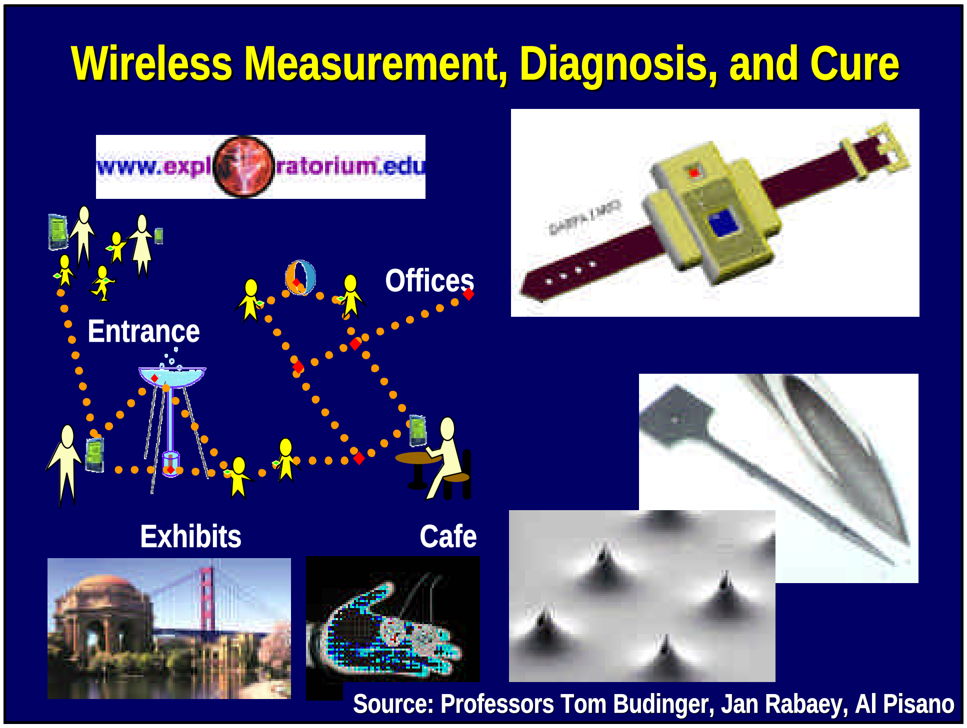
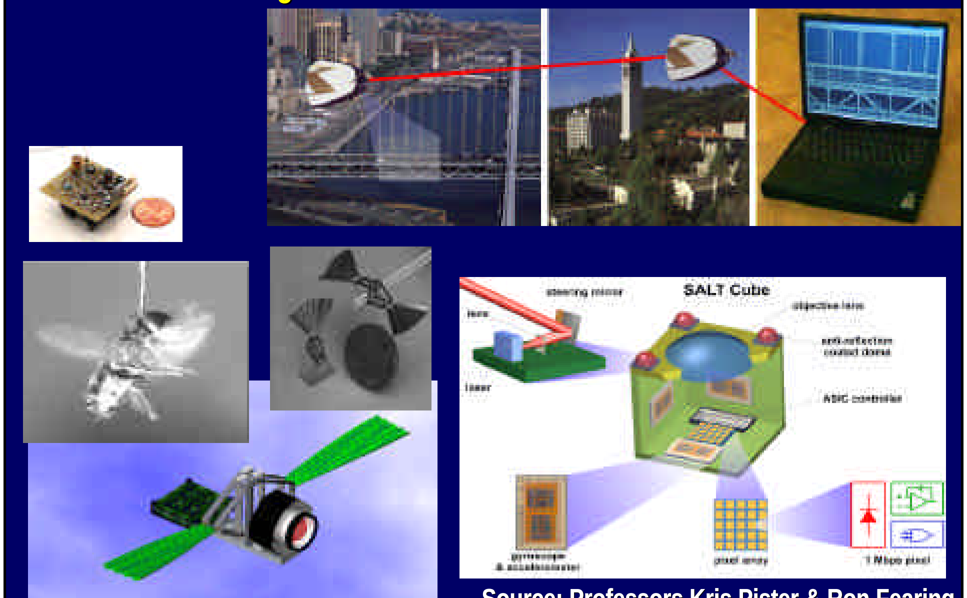

Wireless Measurement, Diagnosis, and Cure
www.exploratorium.edu
Entrance
Offices
Exhibits
Cafe
Source: Professors Tom Budinger, Jan Rabaey, Al Pisano


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



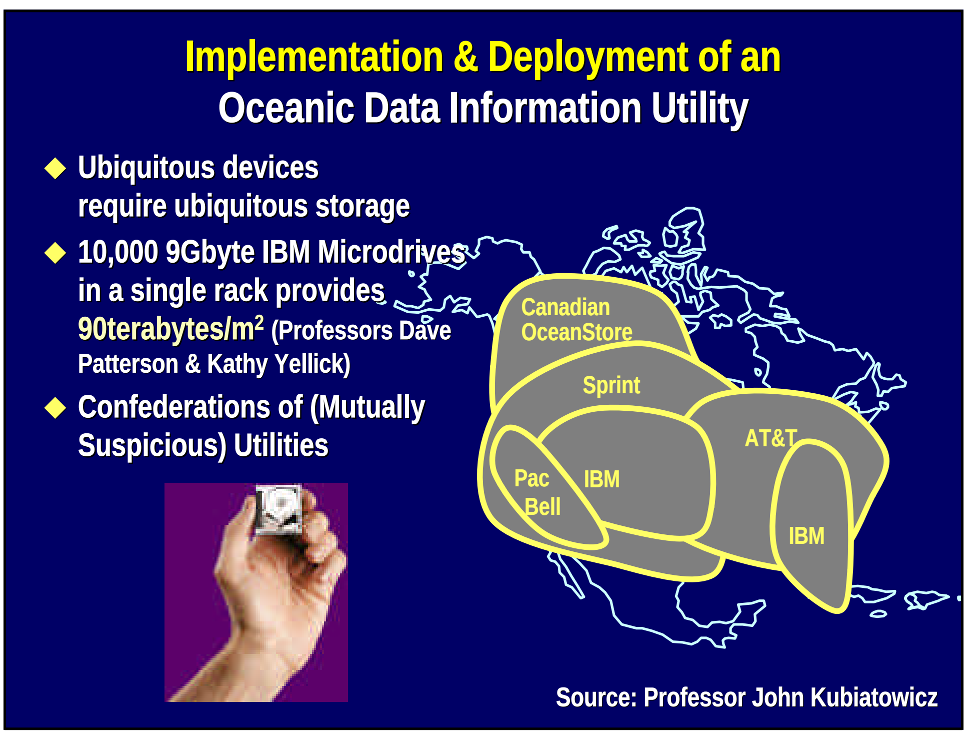
Source: Professors Kris Pister & Ron Fearing

Mote and *TinyOS* Demonstration at 29 Palms

- UAV drops nodes along road:
  - hot-water pipe insulation for package
- Nodes self configure into linear network:
  - Synchronize to 1/32 sec
  - Calibrate magnetometers
    - correct for earth's magnetic field
  - Each detects passing vehicle
  - Share filtered sensor data with five neighbors
  - Each calculates estimated direction & velocity
  - Share results
- As plane passes by:
  - Joins network
  - Upload as much of missing dataset as possible from each node when in range

7.5 KBytes of code!

Source: Professor David Culler



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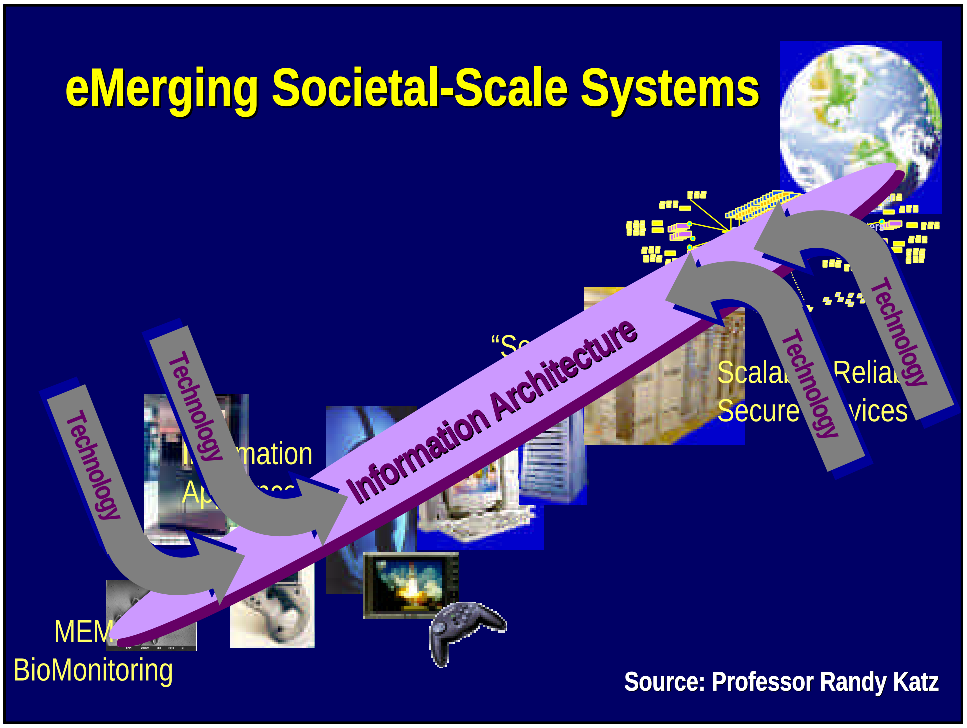

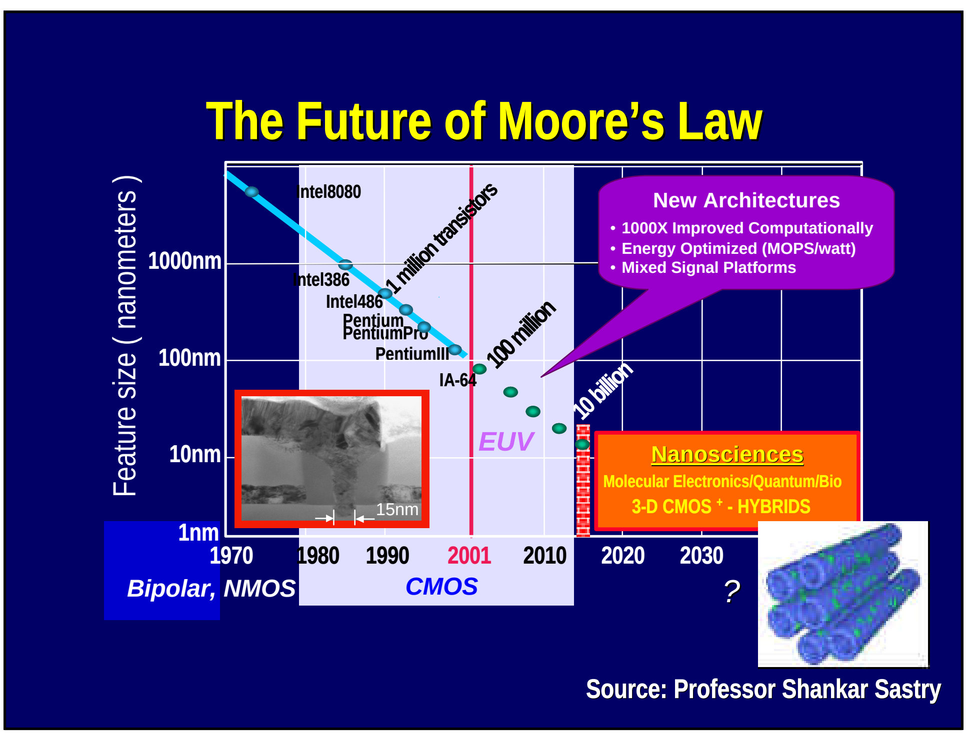

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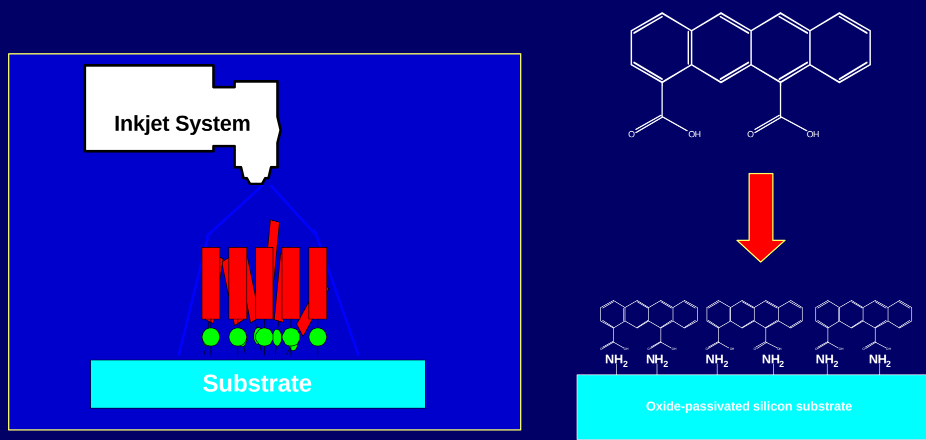
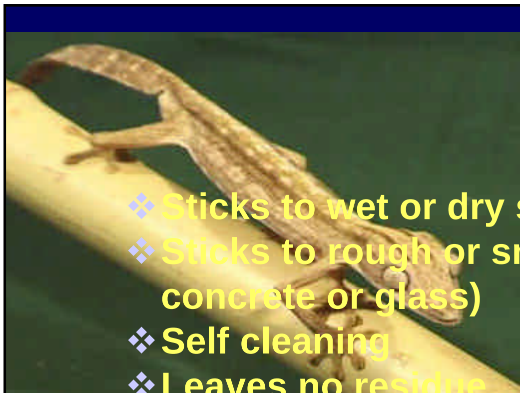
High-performance Printed Circuits



Source: Professor Vivek Subramanian

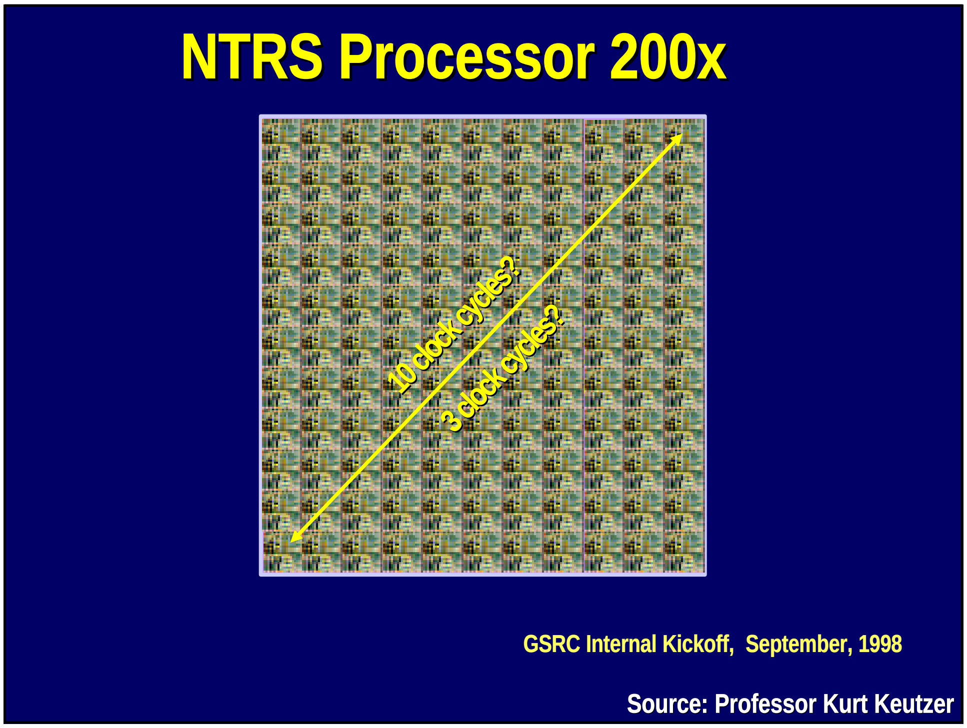


Gecko Adhesive

- 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^2

Goal: artificial nanofabricated structures with gecko adhesive performance

Source: Professor Ron Fearing



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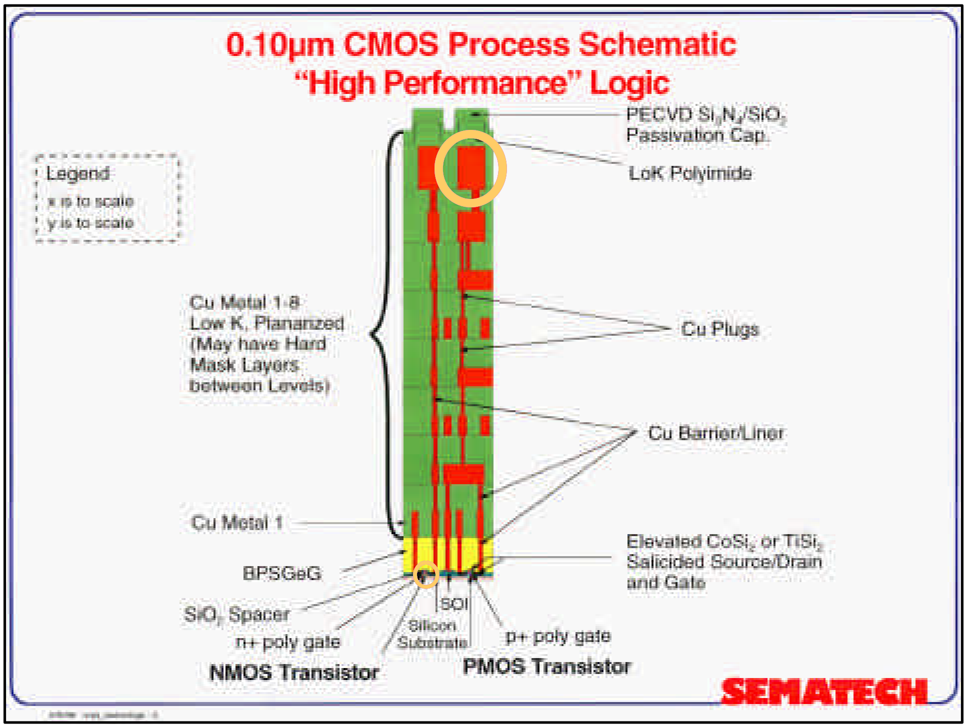

0.10µm CMOS Process Schematic
"High Performance" Logic
PECVD Si3N4/SiO2 Passivation Cap
LoK Polyimide
Legend
x is to scale
y is to scale
Cu Metal 1-8
Low K, Planarized
(May have Hard
Mask Layers
between Levels)
Cu Plugs
Cu Barrier/Liner
Cu Metal 1
Elevated CoSi2 or TiSi2
Salicided Source/Drain
and Gate
BPSGeG
SOI
SiO2 Spacer
Silicon Substrate
n+ poly gate
p+ poly gate
NMOS Transistor
PMOS Transistor
SEMATECH


It's all about Communication!
It's all about Power!
Source: Professor Jan Rabaey

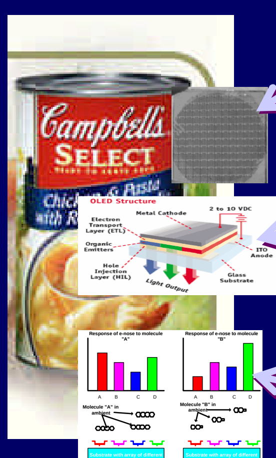
Is the End of Moore's Law an Economic One?

- 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

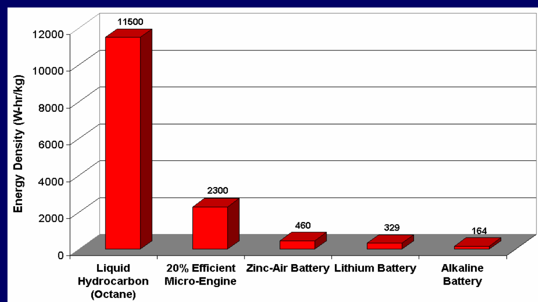
Develop new generations of reflective display technology for ultra-low power "electronic paper" displays No more incorrect pricing!

Closed Loop Content Monitoring

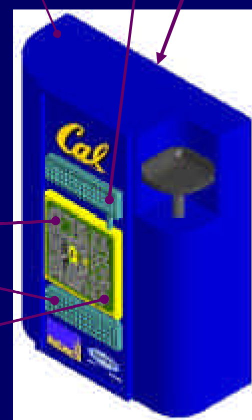
No more expiration dates... the can knows when it has expired!

Source: Professor Vivek Subramanian

A MEMS Microgenerator



Energy density comparison between liquid hydrocarbon fueled power supply and typical batteries



Fuel Reservoir

Electrical Power Output Contacts (reverse side)

Air Intake

Power Conditioning, Logic, and Engine Control

H_2O and CO_2 Exhaust

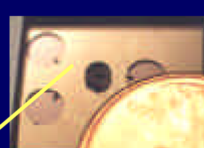
MEMS Rotary Engine and Integrated Power Generator Chipset (PGC)

Source: Professors Carlos Fernandez-Pello, Al Pisano and Dorian Liepmann

The Rotary Microengine

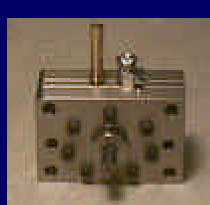
Mini-Rotary Engine

Micro-Rotary Engine

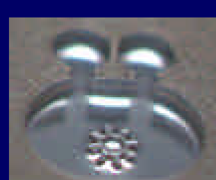


SiC m-rotor (3 mm dia)

- Measured power in mini-engine (3.7 W @ 9300 RPM)
- Fabrication of 3 mm meso-scale engine complete
- Fabrication of 1 mm micro-rotary engine initiated



Mini-engine with integrated liquid fuel carburetor



1 mm micro-engine fabricated from silicon

Source: Professors Carlos Fernandez-Pello, Al Pisano and Dorian Liepmann

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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

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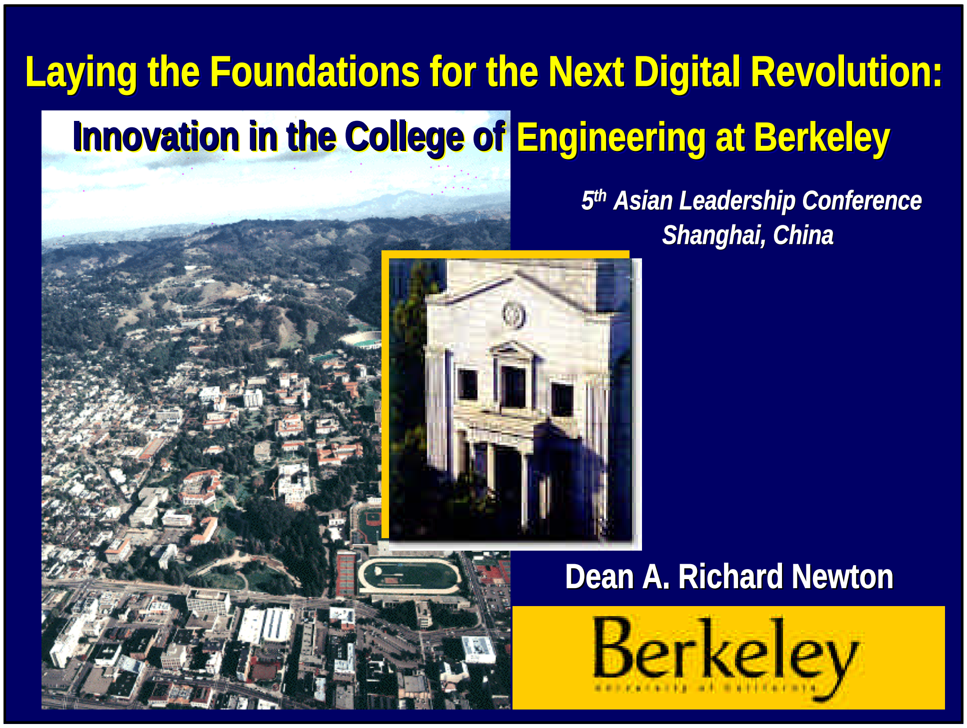
Berkeley Engineering: A Tradition of Impact in Research

- Berkeley Unix
- Relational Database Technology
- Electronic Design Automation: SPICE to Synopsys
- RISC (with Stanford)
- RAID
- CyberCut online manufacturing systems
- NOW (Networks of Workstations)
- IEEE Floating Point
- Infopad (now called WebPad)
- Semiconductor Devices & Modeling
- MEMS

- **Berkeley faculty are fundamentally motivated by high-potential-impact, long-range research**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