Getting Started

- Announcements, instructions, and course documents on **http://inst.eecs.berkeley.edu/~ee40/**
- Also linked with Bspace **https://bspace.berkeley.edu**
- Discussion sections, lab sections, and office hours will begin next week. Read prelab instructions before attending the lab.
- Contact **adabi@eecs.berkely.edu** for lab assignment issues

EE40
Overview

Prof. Nathan Cheung

08/27/2009

The EE40 Teaching Team

- Lecturer

  Professor Nathan Cheung

- Discussion GSIs

  Simone Gambini,

  Ilya Gurin

- Lab GSIs

  Ehsan Adabi Firouzjaei

  Bagher Afshar

  Zhiming Deng

  Onur Ergen

  Rhishikesh Limaye

Class Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00	LAB 11 Cory 140 Deng		LAB 15 Cory 140 Deng		
8:30					
9:00					
9:30		LECTURE 145 Dwinelle CHEUNG		LECTURE 145 Dwinelle CHEUNG	
10:00					
10:30					
11:00	LAB 12 Cory 140 Limaye		Cory Moore Rm Deng		
11:30					
12:00		DIS 103 Cory 285 Gurin	Cory Moore Rm Gurin	Cory Moore Rm Bagher	
12:30					
13:00		Cory Moore Rm Adabi		Cory 513 Cheung	
13:30					
14:00	DIS 101 Cory 241 Gambini	LAB 13 Cory 140 Ergen	Cory 513 Cheung	LAB 16 Cory 140 Bagher	Cory Moore Rm Limaye
14:30					
15:00	DIS 102 Donnor 155 Gambini				LAB 18 Cory 140 Limaye
15:30					
16:00	Cory Moore Rm Gambini				
16:30					
17:00		LAB 14 Cory 140 Ergen	DIS 104 Cory 289 Gurin	LAB 17 Cory 140 Bagher	
17:30					
18:00					
18:30					
19:00					
19:30					

Fall 2009 Teaching Schedule

	Lecture	LAB
Week1	8/27 Overview	No Lab this week
Week2	9/1 voltage,current,power,and energy	Lab 1 Solar Cells
Week2	9/3 resistors, ideal sources,node analysis	Lab 1 Solar Cells
Week 3	9/8 mesh analysis,equivalent circuits	Lab 2: Electronic Scale
Week3	9/10 capacitor and inductors	
Week4	9/15 First order circuits	Lab 2: Electronic Scale
Week4	9/17 Transient response	
Week5	9/22 Phasors, complex impedance	Lab 3: Sensor Interface
Week5	9/24 Filter	
Week6	9/29 Bode Plots	No Lab this week
Week6	10/1 Midterm Exam #1	
Week7	10/6 OP Amp	Lab 4: Timer and Synthesizer
Week7	10/8 Op Amp	
Week8	10/13 Microcontroller	Lab 5: Step-Up Power Supply
Week8	10/15 Binary signals, A/D and D/A conversion	
Week9	10/18 Boolean algebra , Boolean Logic	Lab 6: Microcontroller
Week9	10/20 Semiconductor devices: Diodes,FET	
Week10	10/27 Small Signal model	Lab 6: Microcontroller
Week10	10/29 Amplifiers	
Week11	11/3 Review	No Lab this week
Week11	11/5 Midterm Exam #2	
Week12	11/10 Circuit Simulation(SPICE)	EE 40 project
Week12	11/12 Signal Processing	
Week13	11/17 Logic Circuits	EE 40 project
Week13	11/19 Logic Circuits	
Week14	11/25 IC Fabrication, Perspectives	EE 40 project
Week14	11/27 Thanksgiving	
Week15	12/1 Transducers	Lab Project presentation
Week15	12/3 Review (Last day of class)	
	12/15 Final Exam 8-11am	

Course Information

- **Course Objectives:** This course is intended to teach basic circuit theory and principles of electronic engineering as preparation for subsequent EE courses.
- **Course Format:** 3 hours lecture, 3hours laboratory, 1 hour of discussion.
- **Prerequisites:** Math 1B and Physics 7B
- **Relation to other courses:** EE40 is a prerequisite to every upper division EE course.

Topics Covered

There are four general topics that we will cover as a preparation for future EE courses. Within these four general topics, there are ten topics that will define this course.

1. **Basic Circuits: (Operational amplifiers; EE105, EE140)**
   - Circuit Elements
   - Basic Circuit Analysis
   - Transients
   - Operational Amplifiers
2. **Frequency Response (Signals and Systems, Communication; EE120, EE126)**
   - Frequency Response
3. **Semiconductors & Devices (Solid State Devices, Microfabrication; EE130, EE143)**
   - Semiconductor Physics
   - Diodes & Diode Circuits
   - MOSFET Devices
   - IC Fabrication (save for the last week):
4. **Circuits (Analog and Digital Circuits; EE105, EE140, EE142, EE141, CS150)**
   - Analog Circuits
   - Digital Logic
   - Mirocontrollers

Grading

- Midterm1 15%,Midterm2 15%, Final 30% , Homework 10%, Lab 30%

- **Midterm Exam 1** 10/1(Thursday), 9:30-11:00am
- **Midterm Exam 2** 11/5(Thursday) 9:30-11:00am
- **Final Exam** 12/15 (Thur) 8-11am

- All exams are closed book. Calculators and one new page (8.5" x 11") of notes for each exam will be allowed (i.e. 1 page for MT1, 2 for MT2, 3 for Final).

- College grading policy:
  - "A typical GPA for courses in the lower division is 2.7. This GPA would result, for example, from 17% A's, 50% B's, 20% C's, 10% D's, and 3% F's."

Homework

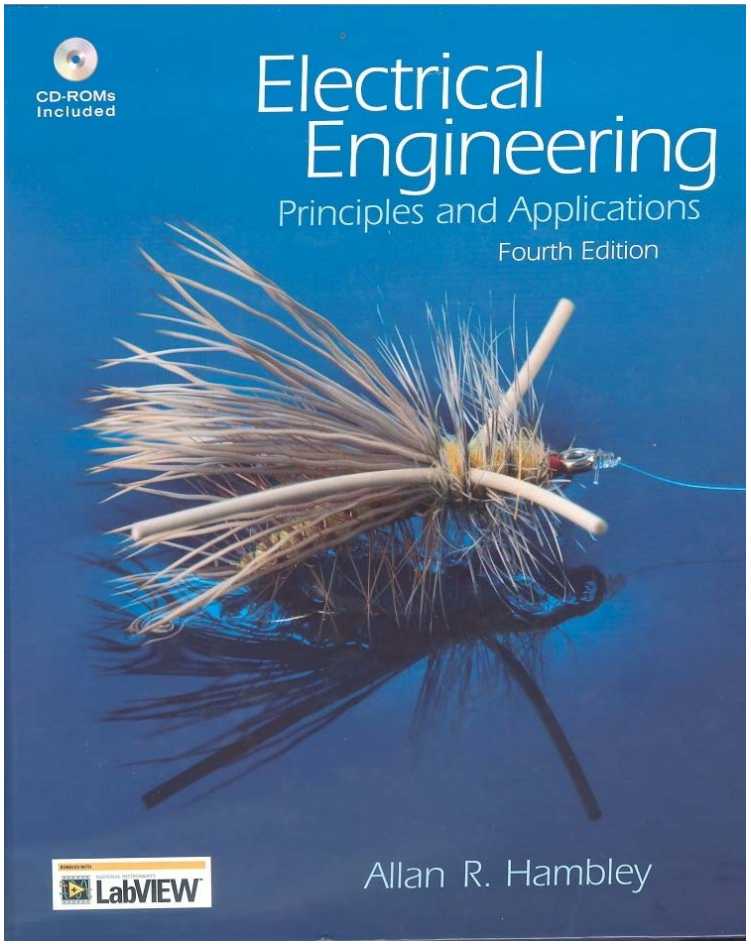
- Posted on class webpage every Tuesday morning and due the following Thursday (12:00 noon) in Cory 240

- No late homework will be accepted

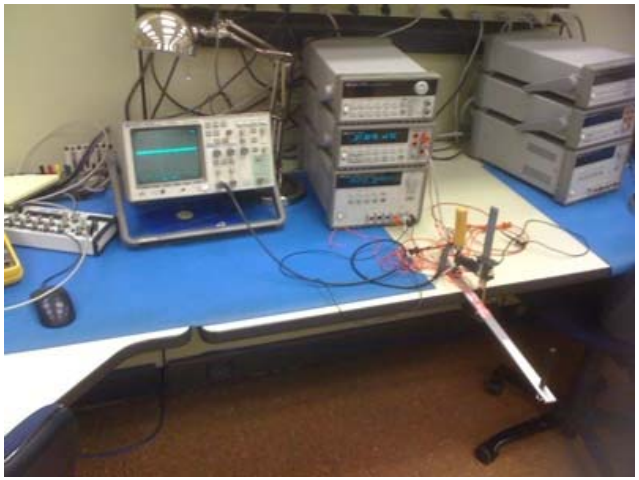
- The two lowest homework scores will not count in course grading

Textbook

- **Allan Hambley, "Electrical Engineering -Principles and Applications," Fourth Edition, Prentice Hall**
- CDROM is optional. Course will provide LTSPICE software for circuit simulation
- Supplement reading materials also provided via class website

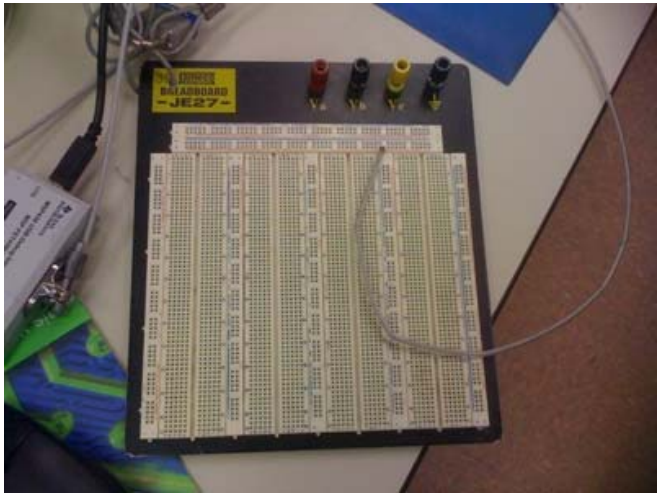


EE40 Lab

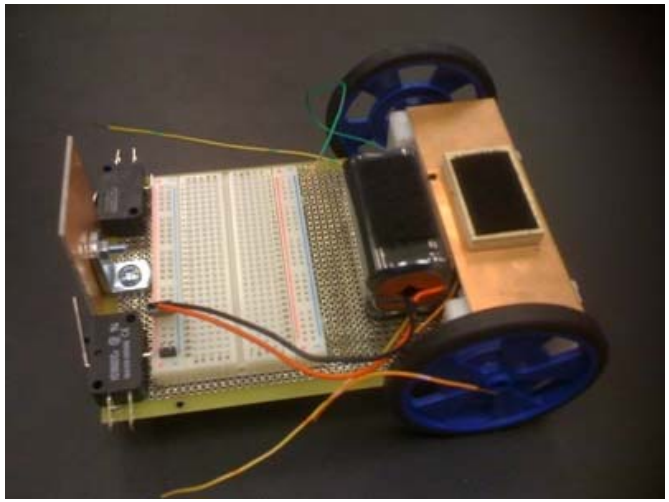


Strain Gauge Sensor

Solar Cells



Breadboarding



Microcontroller

Academic Dishonesty Policy (aka Cheating)

DON'T DO IT!

What is Electrical Engineering?

According to Hambley *(Electrical Engineering Principles and Applications,* Pearson 2008*,* pgs. 4-6):

- Communication systems (cell phones, radio, satellite television, Internet)
- Computer systems (computer applications, appliances, automobiles)
- Control systems (air conditioning)
- Electromagnetics (cellular phones, antennas)
- Electronics (transistors, pacemaker)
- Photonics (DVD readers, holograms, fiber-optics)
- Power system (generators, transformers, distribution lines)
- Signal processing (ignition control in combustion, machine vision for robots in manufacturing)

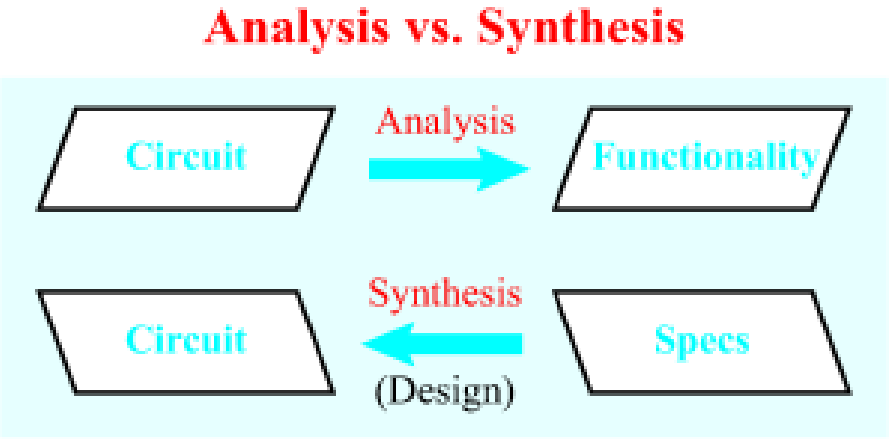
Microelectronic Circuits

Microelectronic circuits condition, manipulate, transmit, receive electrical power (energy) and/or information represented by electrical signals.

1. To distribute, store, and convert *energy* between various forms
   - Examples: electrical utility system, power supplies that interface battery to charger and cell phone/laptop circuitry, electric motor controller, ….
2. To gather, store, process, transport, and present *information*
   - Examples: computer, cell phone, appliance controller, …..

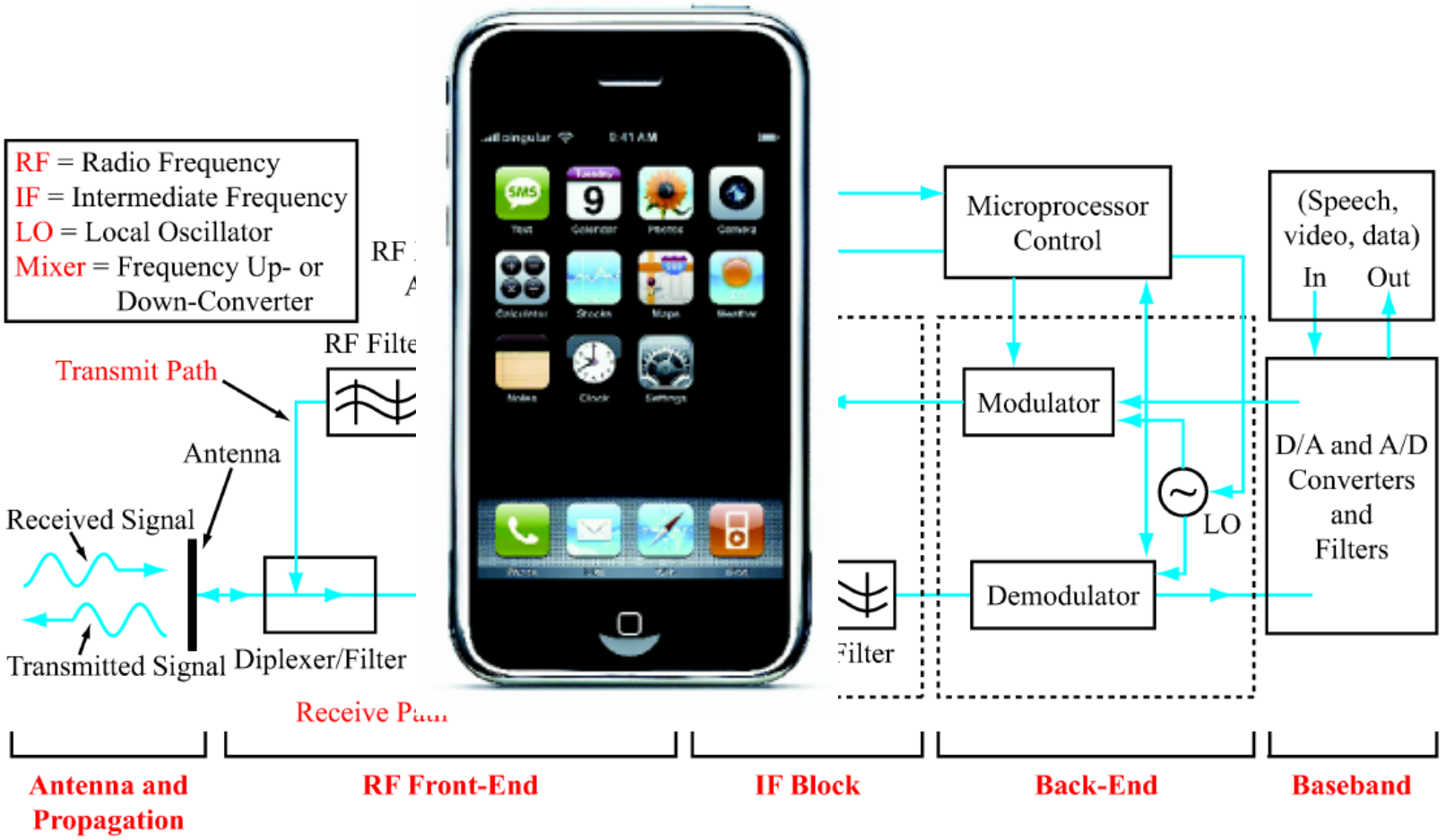
Circuit Analysis

- **Circuit analysis is used to predict the behavior of the electric circuit, and plays a key role in the design process.**

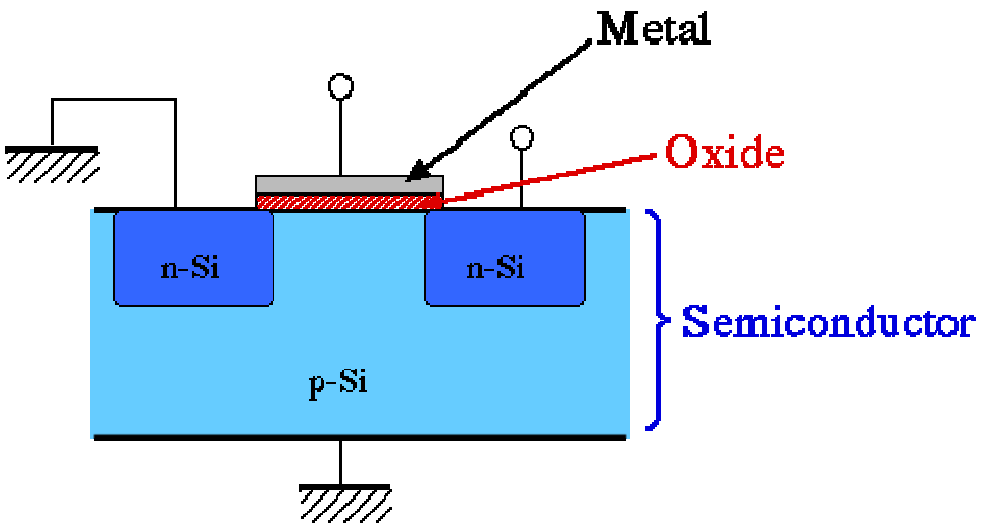


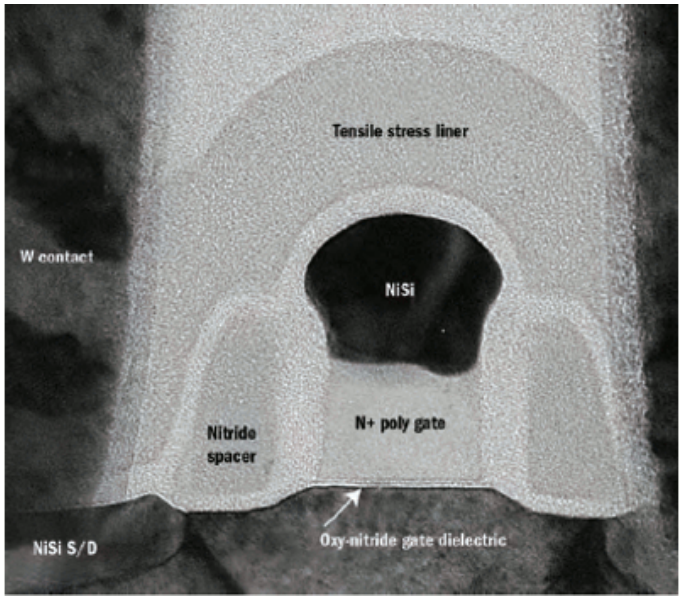
  - Design process has analysis as fundamental 1st step
  - Comparison between desired behavior (specifications) and predicted behavior (from circuit analysis) leads to refinements in design

Inside an iPhone



Transistor in Integrated Circuits

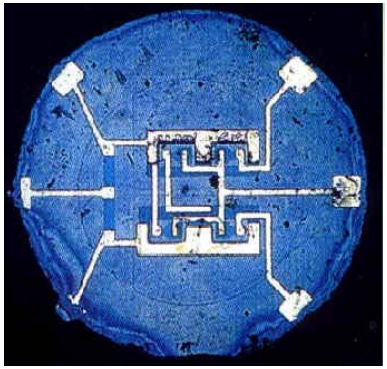




45nm node MOSFET (AMD)

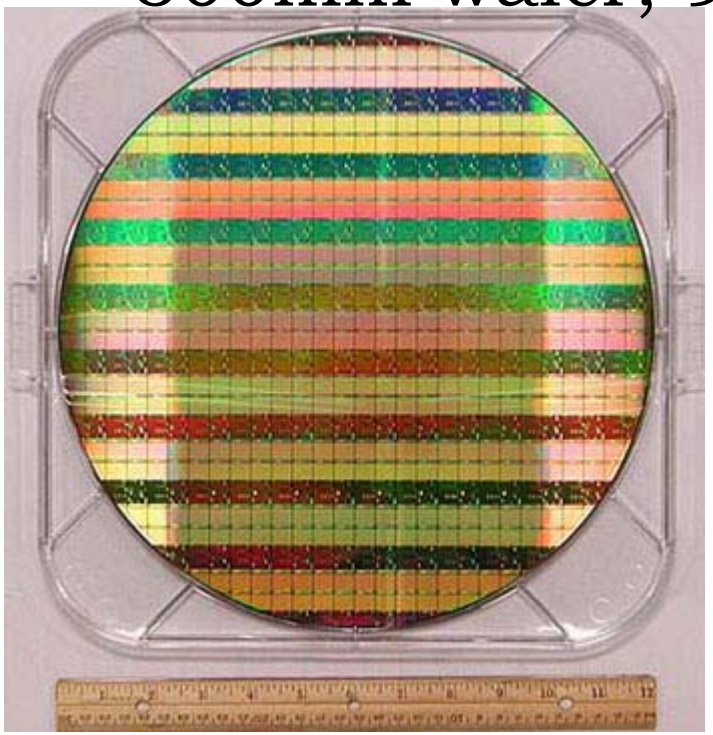
- Transistors are the workhorse of modern ICs
  - Used to manipulate signals and transmit energy
  - Can process analog and digital signals

What is an Integrated Circuit?

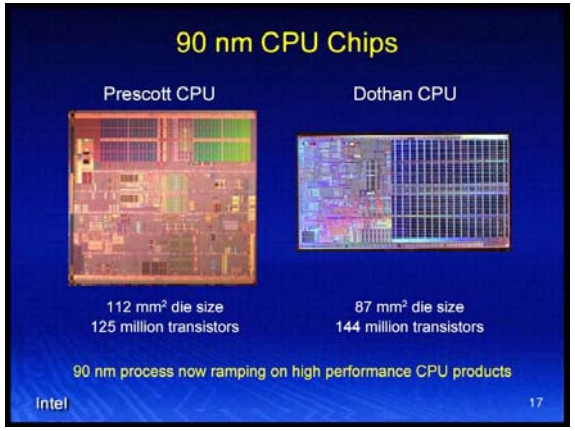


The First IC
(R. Noyce)

300mm wafer, 90nm



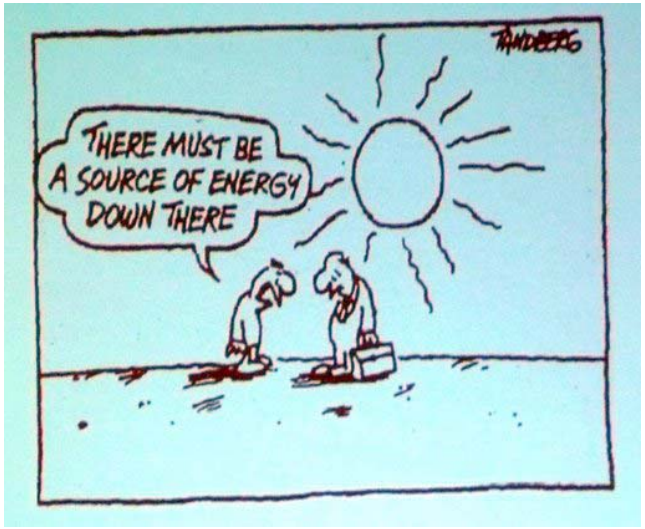
Contemporary CPU
(Intel)

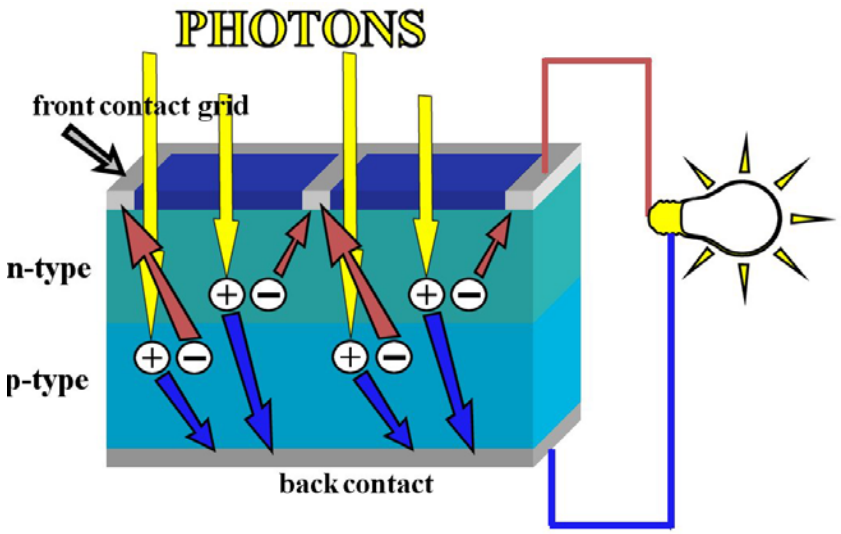


- Designed to performs one or several functions.
- Composed of up to 1000s of Millions of transistors.

Photovoltaics

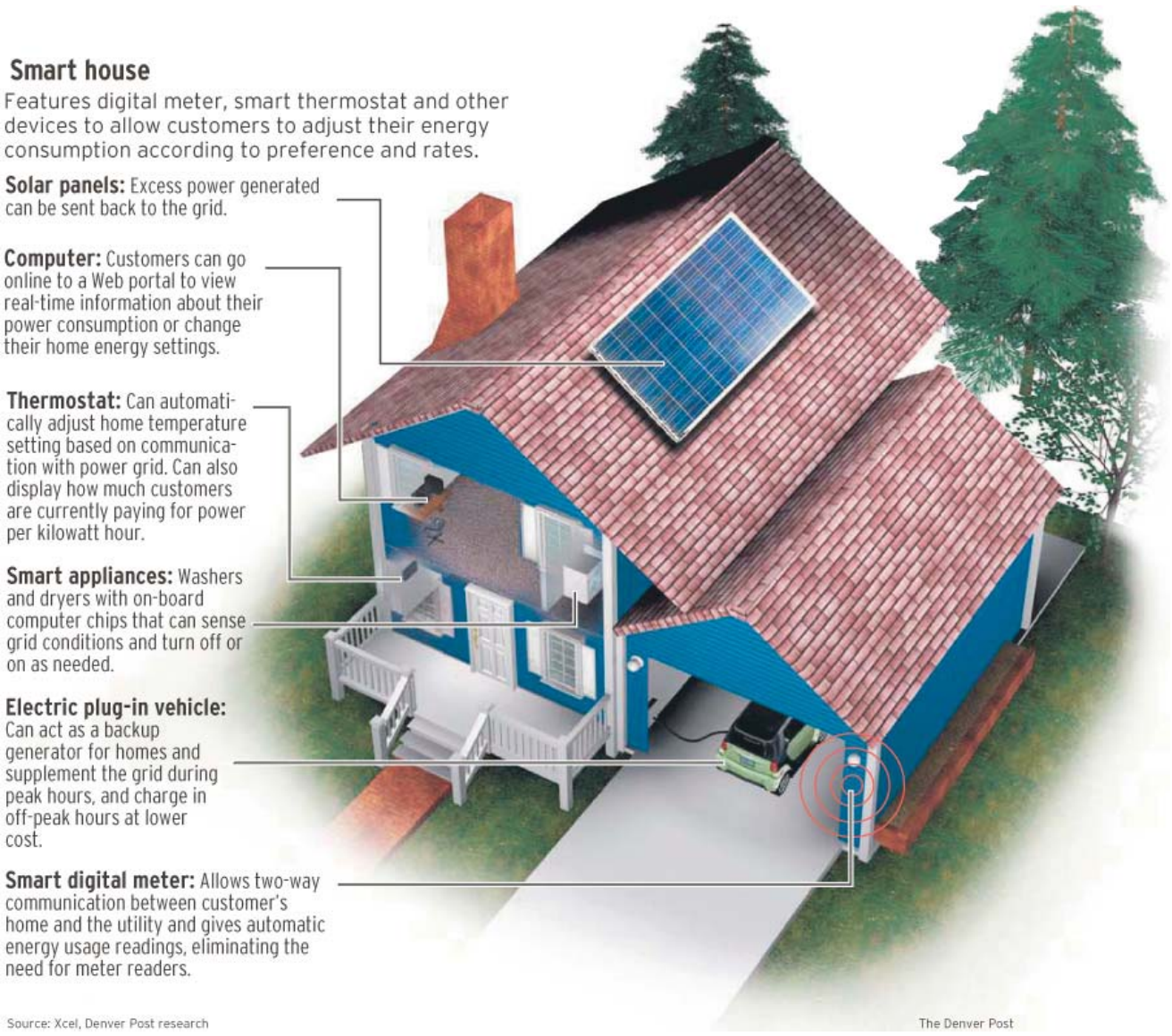
- US Total Power Plant Capacity 600GW (28% of world) and will grow 30% by 2030
- PV cells - $0.25-0.39/kWhr
- Coal plant - $0.06/kWhr
- **PV < $0.10/kWhr to be price competitive!**



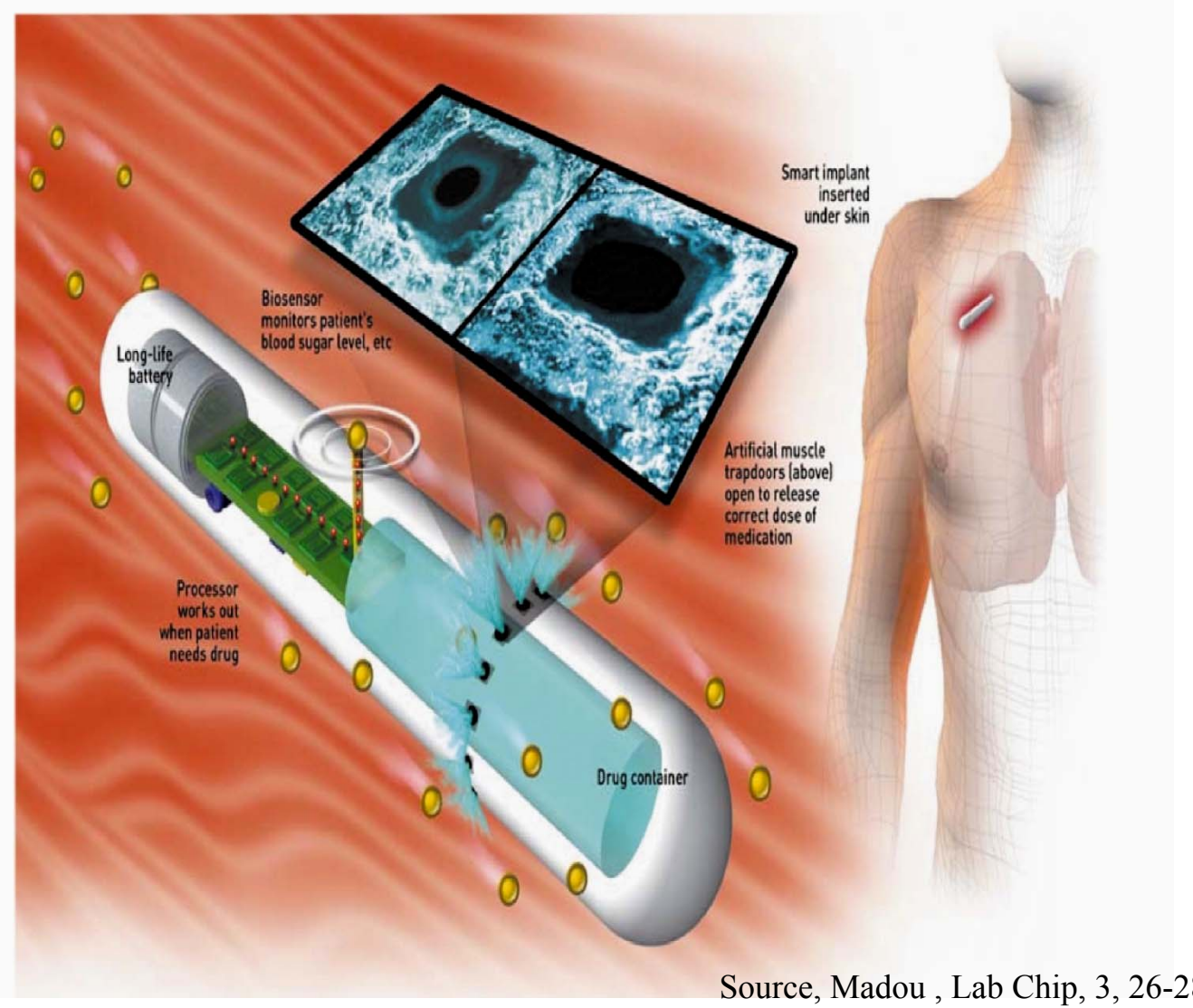


The SMART Grid

The SMART House



Bio-MEMS: Responsive Drug Delivery System



Source, Madou , Lab Chip, 3, 26-28N (2003)