Nanoelectronics • Architectures

MIND

MIDWEST INSTITUTE FOR NANOELECTRONICS DISCOVERY

The MIND Initiative

Overview and Opportunity

Indiana Economic Development Association

June 13, 2008

Patrick M. McMahon
Project Future

MIND

An Edge Makes All The Difference

1679	LaSalle – *St.Lawrence to Mississippi*
1831	Shirley & Bog Iron
1832	Foundry – St Joe Ironworks
1852	Studebaker Blacksmith Shop
1868	Studebaker Manufacturing Co. – Wagons
1904	Studebaker – Autos
1895	Revra DePuy – Orthopedics
1906	1st (US) Steel Plant – Gary Indiana
1913	Ford starts 1st assembly line

These events provided us with a significant manufacturing edge

An Edge Makes All The Difference

US Auto and Steel Industries

Subcontract Manufacturing and Services

Question:

In light of our transitioning economy, what is the biggest question facing the communities of the Midwest?

“Where do we find our next edge?”

Where Is Our Next Edge?

Something is happening in the world of high-speed electronics.

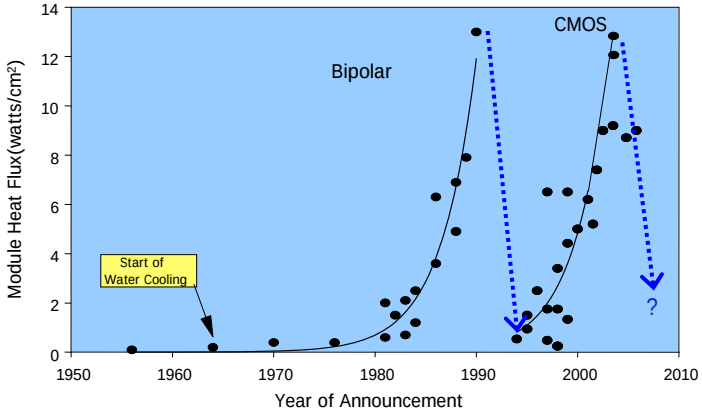
The U.S. (and world) semiconductor industry is about to hit a wall with it’s silicon chip technology.

It is a power and size barrier

Something Is Happening

Power is The Problem

and it has happened before . . .

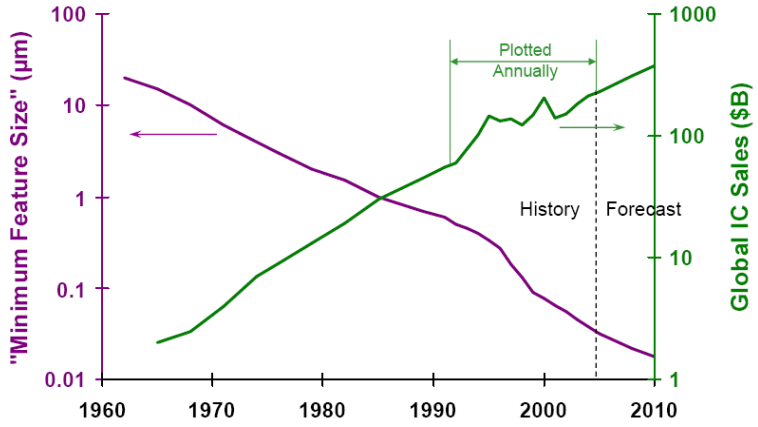


Next 10-15 years: New technology enhancements

Continued CMOS shrinking, multi-core chips, 3D packaging, new memory devices, etc.

Something Is Happening

Scaling = Progress in Electronics



Smaller features → Better performance & cost/function → More apps → Larger market

Something Is Happening

When was the last time you bought a faster computer?

The world semiconductor industry

is hotly in pursuit of the next logic device

that will replace the current silicon chip

Something Is Happening

The US manufacturers have locked arms to win this race

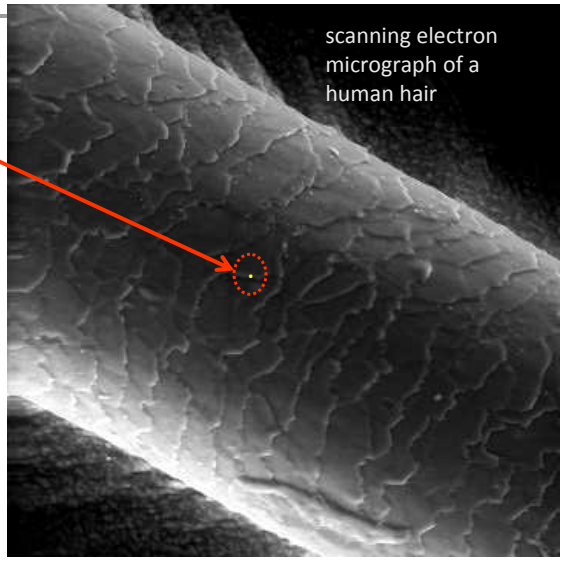
The ***Semiconductor Research Corporation*** was been created to advance the research targeted at finding the new device.

They are pursuing a NANO solution

Nanometer (10^{-9} m = 0.000,000,001 m)

1 transistor switch would fit in the dot

6 million transistors on the head of a pin



http://resolution.umn.edu/MMS/ProjectMICRO/Schools/Index.htm
400 nm dot drawn at the center of a human hair

Corporate Partners

Six of the Semiconductor Research Consortium's corporate partners have pooled millions of dollars and created the **Nanoelectronics Research Institute**

IBM · Texas Instruments · Micron · freescale semiconductor · AMD · intel

Corporate Partners Driving Research

The Nanoelectronics Research Institute (NRI)

2006 - Three National Research Centers

Purpose:
Identify, develop and commercialize
the nanoscale logic device that will replace the current silicon chip

Corporate Partners Driving Research

The Nanoelectronics Research Institute (NRI)

Created A Fourth National Center in 2008

Nanoelectronics • Architectures

MIND

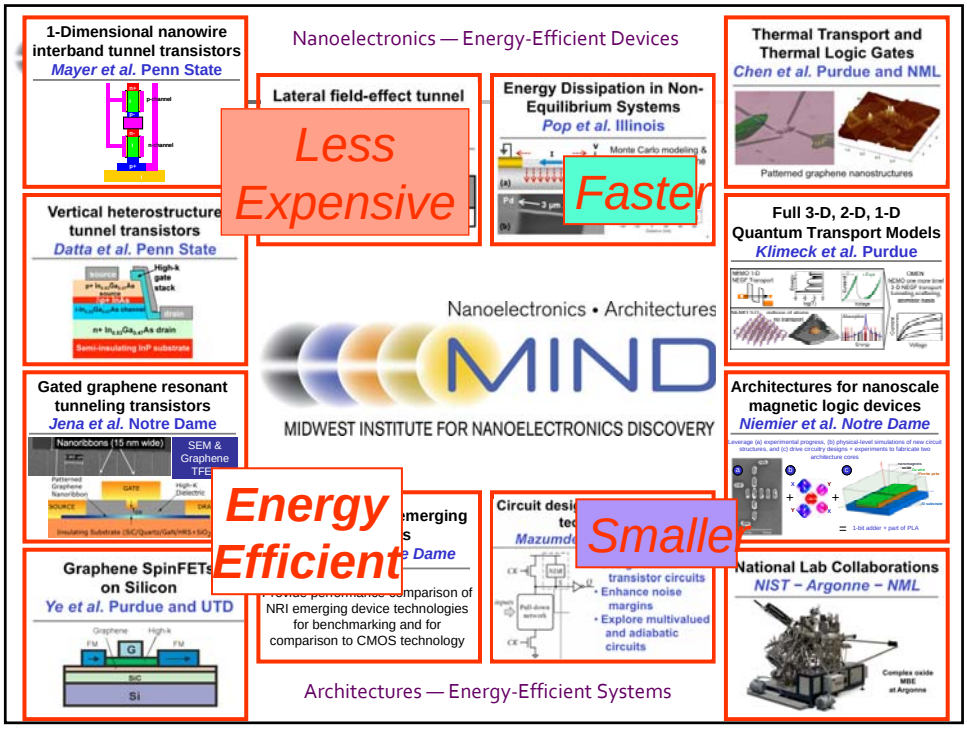
MIDWEST INSTITUTE FOR NANOELECTRONICS DISCOVERY

MIND is…

- Universities:
  - Notre Dame
  - Purdue
  - Michigan
  - Illinois
  - Penn State
- National labs:
  - National Institute of Standards and Technology (NIST)
  - Argonne National Laboratory
  - National High Magnetic Field Laboratory

NRI Funded Universities

35 Universities in 20 States



Why This Activity Is Unique

- Unlike most all other university-based research activities, this effort is not a great idea trying to find a sponsor or a home.
- Six of the world's leading semiconductor companies have chosen to actively engage **Indiana's** expertise in nanotechnology, and are waiting to immediately commercialize its results.

IBM intel freescale semiconductor Micron AMD Texas Instruments

Why This Activity Is Unique -- *more*

- The industry change is upon us
  - Current physical and technological limitations REQUIRE the semi-conductor industry to change the basic building block of electronics and all of the devices that use electronics.
  - The NRI expects that the early-stage prototyping for the new device will begin within 3 to 5 years.
  - The NRI expects that the new device will displace the silicon chip within 12 years, by 2020

Why This Activity Is Unique -- *more*

- The change will be highly disruptive: introducing new materials, new manufacturing facilities, and new applications.
- The Midwest Institute is uniquely focusing upon the creation of the architectures that will allow the new device to be used in a wide variety of applications.
- This is a rare chance to step into a major proto-typing role for a **trillion** dollar industry, an opportunity to engage with and host economic activity that has previously been a west, southwest and northeast activity.

MIND Will…

- Change the way the world works, and Indiana's researchers will be leading the way
- Fast-forward Indiana into a massive segment of the knowledge economy, and will give the state a new competitive edge on the world stage
- Enable communities around Indiana to participate and benefit

MIND Will Also…

- Precipitate significant investment
- Stimulate business growth
- Provide Indiana with an opportunity to establish the intellectual property and business relationships capable of transitioning large segments of its economy

The Bottom Line on MIND

Nanotechnology
may be more significant to
Indiana's economic future than
even the automotive, steel, and
pharmaceutical industries have been.

A Local Response

- Strong local government financial commitment
- Renewed and strengthened relations with Notre Dame, setting the stage for university-linked economic development - Creation of IP @ ND – Significant support for prototyping activities
- Massive new real estate development linking city and campus, including the reinvention of the former Studebaker Corridor
- Major expansion of research funding by Notre Dame
- Establishment of a community-wide strategic plan identifying those assets that must be modified if the community is to see research and commercialization create local employment

Indiana's Commitment

- Gov. Mitch Daniels announced MIND in March
- Bi-partisan legislative leadership support
- State Finance Committee hearing on $12-million to support MIND's operating expenses

Will We Step Up?

Our involvement with this trillion+ industry can be a life-changing event for the economy of our communities, the State of Indiana, and the Midwest region

IEDA's Opportunity

Think of MIND and the transition occurring in nanoelectronics as a new strategy for economic growth and development

- For our state
- For our communities
- For our universities, colleges and tech colleges
- For our people

Our Challenge

- Recognize the economic power of leveraging Indiana's intellectual assets
- Increase support for the efforts of Indiana's universities to transfer their knowledge to the marketplace
- Create focused community and regional infrastructures that support research-based enterprises

Summary

- MIND is real and it is here...
- MIND signals a new economic era...
- MIND will challenge us...
- MIND will reward us...and
- MIND will transform us

If we rise to the opportunity it presents.