Semiconductor Research Corporation

2nd Bioelectronics Roundtable

Overview and Introduction

Celia Merzbacher, Ph.D.
Daniel J.C. Herr, Ph.D.
Semiconductor Research Corporation

Janelia Farm Research Campus
Ashburn, Virginia

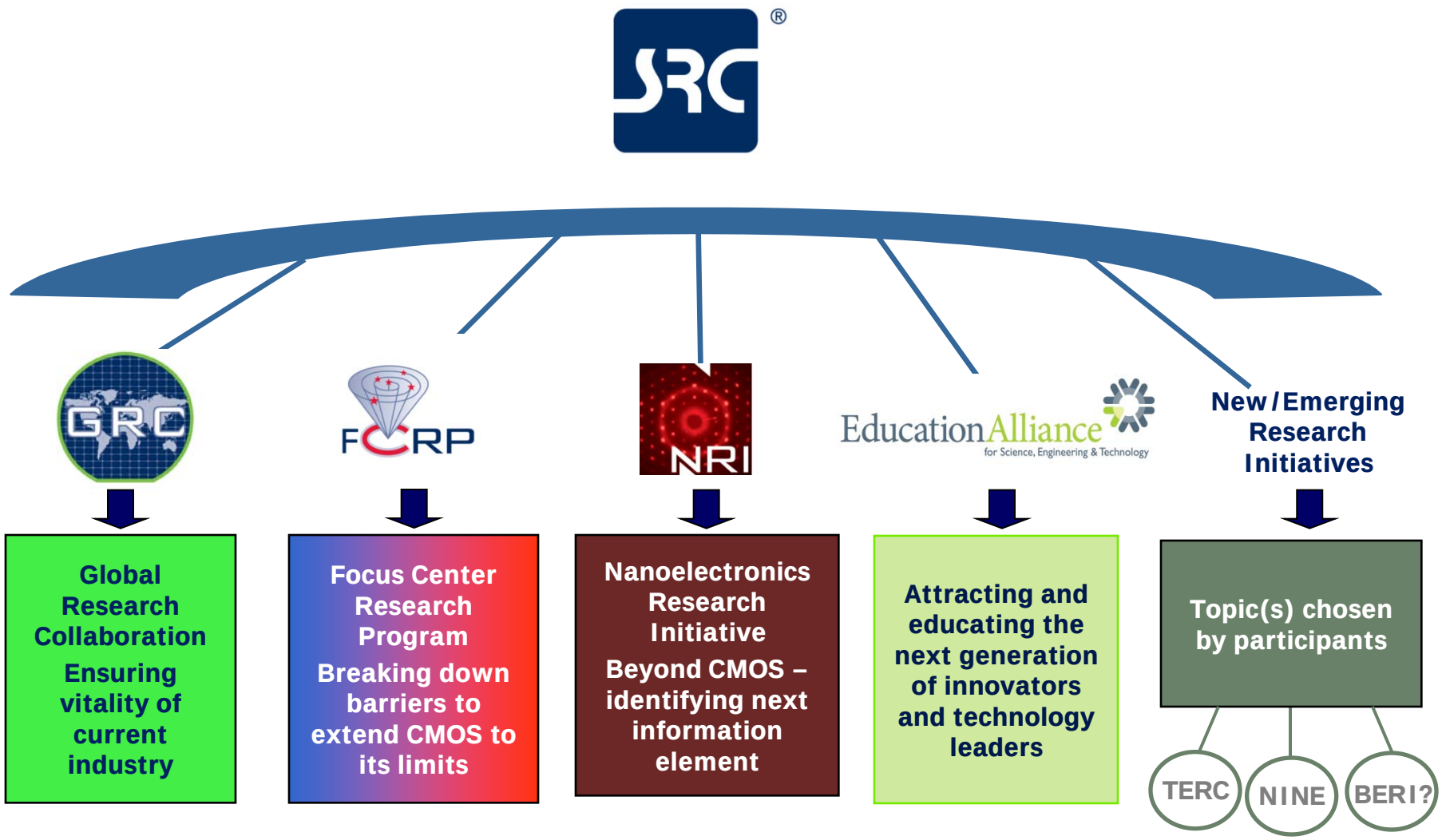
March 25-26, 2010

Background

- Advances in semiconductor/electronic technology + bio/medicine = potential new solutions/products
- Market drivers include aging population, underserved populations (in rural areas and developing countries), injured veterans, demand for affordable healthcare.
- Industry sectors have not collaborated on fundamental research.
- Coordinated investment among semiconductor and biomedical industries in strategic, application-driven basic research can increase competitiveness of all.
- SRC has over 27 years of experience managing consortia-based research.

Semiconductor Research Corporation

A Family of Distinct, Related Program Entities

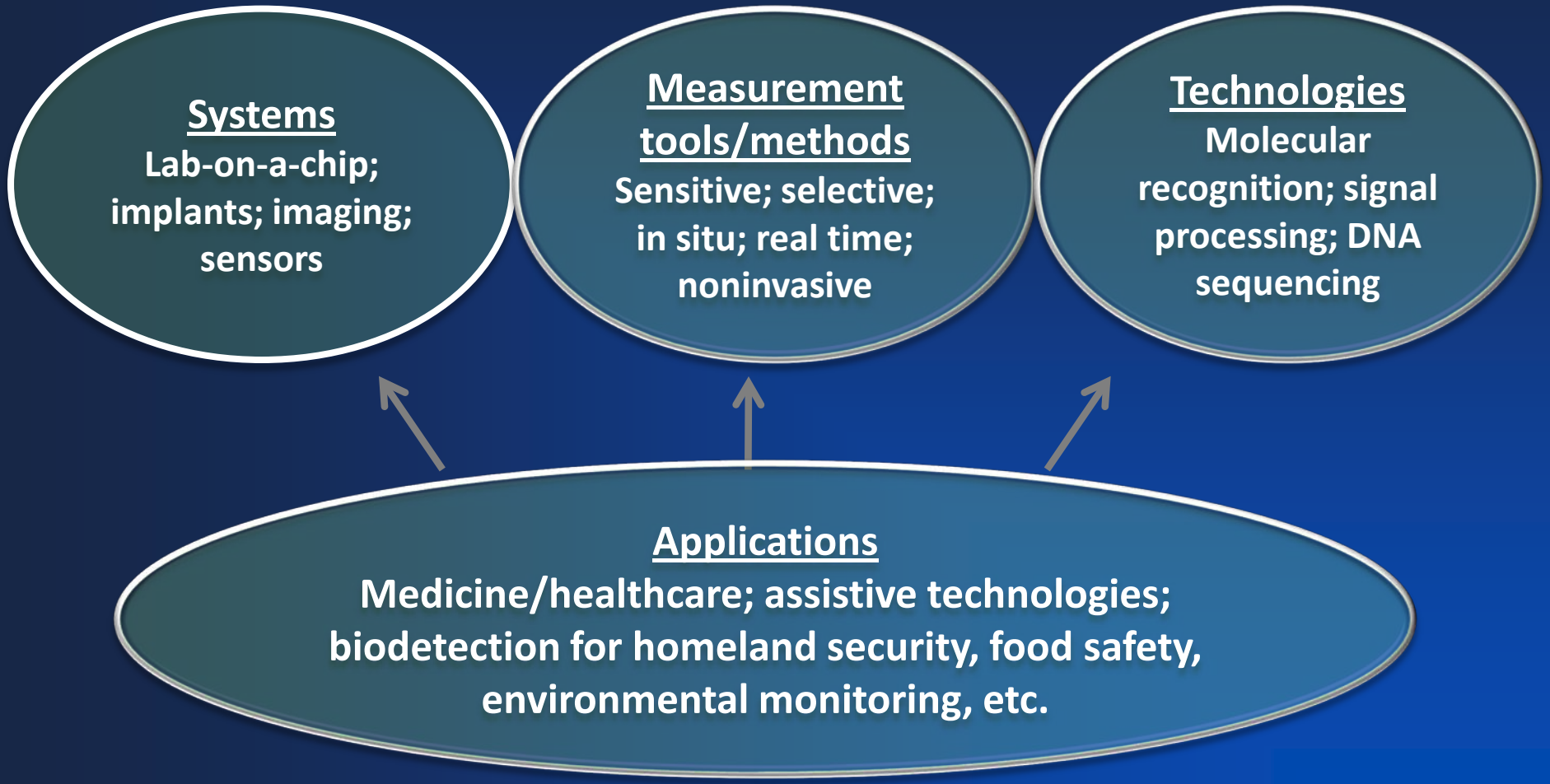


Background: BERT1

- 1st Bioelectronics Roundtable held Nov 2008
- Identified a cornucopia of applications and underlying science and technology challenges.
- Recommended next steps:
  - Identify priority applications
  - Develop a research plan to address challenges

http://www.src.org/trc/bio/docs/reports.asp

Application drivers have common challenges



Cross-cutting challenges: bio/nonbio interfaces; power supply/management; data collection/transfer/analysis; software

Goal of 2nd Bioelectronics Roundtable

- Identify priority research opportunities that are of interest to multiple (potential) sponsors and in which exclusivity is not required.
- Research opportunities should have the following characteristics:
  - ✓ Dependent on advances in bio + semiconductors that remove barriers to progress
  - ✓ High impact
  - ✓ Driven by (relatively) long-term application need
  - ✓ Basic, fundamental, and “use inspired”
  - ✓ Enable breakthrough improvements over current technologies
  - ✓ May be crosscutting with use in multiple applications
  - ✓ Feasible
  - ✓ Suitable for academic environment
    - Nonproprietary
    - 3-year timeframe

Factors for prioritizing applications/research

- Why does this application warrant consideration now?
- If successful, what is the potential impact of this application and what are its benefits/advantages over current capabilities/technologies?
- What specific research needs are driven by this application?
- What are the research targets or metrics for success?
- What are the projected research resource requirements?

Example Research Opportunity: Artificial Pancreas

Application

- **Driver:** Improve health and quality of life of people with type 1 diabetes;
- **Market size:** Over 23 million diabetics in U.S.; 5-10 percent are Type 1.
- **Need:** An automated artificial pancreas system that provides real-time control of insulin delivery based on dynamic blood sugar level.

Research Needs

Scientific/technological problems and barriers:

- Power scavenging, storage , and management;
- Software and system control algorithms;
- Bioelectronics to support components of a mechanical closed loop system and /or encapsulated living tissue, without rejection.

Advantages

- **Impact, if successful:** Reduce deadly acute and chronic complications (blindness, loss of digits, etc.) and improve quality of life by reducing invasiveness of glucose monitoring and control.
- **Benefits/advantages over current capabilities or technology:** Personalized, dynamic insulin monitoring and delivery to better control glucose levels with little/no involvement of the patient.

Metric(s) of Progress

- **3 Year Goal**
  - Demonstrate feasibility of an implantable semi-automated glucose monitor and controlled delivery system.
- **5 Year Goal**
  - Demonstrate feasibility of an implantable, integrated , and automated mechanical glucose control system and /or a system based on hybrid bioelectronics-encapsulated and controlled living tissue system.
- **10 Year Goal**
  - Demonstrate feasibility of an integrated, automated and implantable glucose control system, based on hybrid bioelectronics-biocompatible tissue system.

Resource requirements **Annual cost :** ~$1M/year**; People:** 3-6 Faculty **;**
Facilities: Access to nano-electronics fabrication and clinical test facilities.

AGENDA: Day One

7:30-8:30	Breakfast
8:30-8:45	Welcoming remarks by Kevin Moses, Janelia Farm
8:45-9:00	Review of roundtable program and goals
9:00-11:30	Session 1: Ex vivo systems Overview by Madoo Varma (Intel Corp.)
11:30-12:30	Lunch
12:30-3:00	Session 2: In vivo systems Overview by Jack Judy (DARPA)
3:00- :20	Break
3:20-5:50	Session 3: Imaging Overview by Jonathan Murray (GE Healthcare)
6:30-7:30	Dinner
7:30-	Informal networking at on-site pub

AGENDA: Day Two

7:00-8:00	Breakfast
8:00-8:20	Bioelectronics R&D at the A*STAR Institute for MicroElectronics Tushar Bansal (A*STAR IME, Singapore)
8:20-8:30	Overview of Day 2 Goals
8:30-10:00	Breakout Group Discussions on Research Needs
10:00-10:30	Session Summaries
10:30-10:45	Prioritization of Research Opportunities
10:45-11:00	Break
11:00-12:15	Session 4. Wrap-up
	Summary/discussion of prioritization and next steps
12:15	Adjourn
12:15-1:15	Lunch [Optional]
1:15-2:15	Tour of Janelia Farm Research Center [Optional]

Breakout Group Processes and Procedures

Breakout groups are diverse; constant; work in parallel; highly interactive

Day 1: Focused on application drivers in three areas of bioelectronics

- **Identify top application drivers:**
  - Each participant names **one** application driver of interest
  - Solicit additional applications
  - Discuss strengths/weaknesses of all applications under consideration
  - Participants prioritize applications individually
  - Conduct a show-of-hands vote, if needed, with each participant voting for ~1/3 of the applications
- **Reach consensus:** Review and reach consensus on the top 3-4 application drivers.
- **Homework:** Review the research needs and targets/metrics for progress for the applications prioritized by your breakout group in all three sessions.

Breakout Group Processes and Procedures

Day 2: Focus on Research Needs

- **Clarify Research Needs:**
  - Review/discuss/modify the research needs for the top application drivers from all three sessions on Day One
  - Identify any research needs that are common/cross-cutting
- **Review Research Targets:** For each priority application driver, identify 3-, 5-, and 10-year targets/metrics of progress

Following the breakout sessions, results will be summarized and participants will vote for top application-driven research across all areas.