

### Research in Industrial Labs: How Collaboration Aids Innovation

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### **Overview**





# Life in a Research Lab





# Life in a Research Lab: Sun Microsystems Laboratories

- Applied research aligned with company business
- Expert in *n* engineering fields, but knowledgeable in *m* (where m > n)
- Communicate and collaborate with colleagues
- Collaborate with universities
- Contribute to open-source and standards initiatives
- "Innovate, Demonstrate, Transfer"



# **VLSI Circuit and CAD Research**





### **Usual Interaction Model**

#### Company A Circuit Design

### Company B CAD Development



## **Usual Interaction Model**



Sun Microsystems Laboratorics



# **VLSI Circuit and CAD Research Group**







# **VLSI Circuit Research**





# **VLSI Circuit Research**

- Design circuits to enable novel architectures
- Low-power circuits
- High-speed circuits
- Communication Links
- Asynchronous circuits



# VLSI Circuit Research: Proximity Communication (1/4)

• What is a capacitor?



- > Parallel metal plates form a capacitor
- > Change in voltage on one side results in corresponding change on the other side
- > Can only communicate changes, not real values



# VLSI Circuit Research: Proximity Communication (2/4)





# VLSI Circuit Research: Proximity Communication (3/4)





## VLSI Circuit Research: Proximity Communication (4/4)



Comparison of Scale

**Proximity Communication** 



Area Ball Bonding





# **VLSI CAD Research**





# VLSI CAD Research:

- Challenges
  - > Design sizes
  - > Acceptable performance
  - > Hierarchical representation
  - > Shrinking technologies
- Source of research topics
  - > Handling of large data set
  - > Geometric algorithms
  - > Visualization
  - > Collaboration



Collaboration with Harvey Mudd



# **VLSI CAD Research**

- In-House and Third-party
- CAD Tools
  - > Logical Effort
  - > Analysis
  - > Route and placement
- Software Research
  - > Client/server model
  - > 2D/3D visualization



Stipple Patterns

Java3D Transparency



Metal Cage Structure



# **Collaborative Research Framework:**

- Electric VLSI Design System<sup>™</sup>
- Technical benefits for HW/SW
- Java development platform
- External/Open source community
  www.staticfreesoft.com
- Dynamic development cycle



#### **Electric Framework**



# **Making Test Chips**





### **Chip Building Process**









### **CAD Testing Process**







### **1.**Schematic Entry and Transistor Sizing

> Logical Effort support











**1.**Schematic Entry and Transistor Sizing

### 2.Simulation

- Interface to CAD Tools of Our Choice
- > Waveform Viewer and Cross-Probing











1.Schematic Entry and Transistor Sizing2.Simulation

### 3.Layout

- > Network Consistency Checker (NCC)
- > Design Rules Checker (DRC)
- > Automatic fill generator
- > Routing, auto stitching tool













1.Schematic Entry and Transistor Sizing2.Simulation

3.Layout4.Fabrication



Foundry Input



Foundry Output













**1.**Schematic Entry and Transistor Sizing

2.Simulation

3.Layout

4. Fabrication

**5.**Testing







# **Research Application: Switch Prototype**





# **Research Application: Switch Prototype**



Scalable Switch for Data Centers





# Conclusions

- Collaboration across research areas
- Teamwork and communication important
- Opportunities for people from different backgrounds
- Often solving "real-world" problems
- Easier path to productization
- Research is fun!
- For more information:
  - > http://research.sun.com
  - > http://research.sun.com/vlsi

# **Technology Transfer Leadership**

#### Technology

- Honeycomb to Network Storage
- Elliptic Curve Cryptography libraries to Java Enterprise Server products
- FreeTTS, Sphinx IV to Solaris, Accessibility
- Conceptual Indexing Search to Java App Server and Java Web Server
- Async technology to USIIIi
- Java™
- SPARC V9 Architecture Specification
- Sun Ray<sup>™</sup> 1, Wide Area Sun Ray technology
- Concurrent GC to Java SW
- Liberty architecture
- Sun Cluster™ 3.0
- Awarenex
- JINI<sup>™</sup>

#### **Open Source**

- Elliptic Curve Cryptography to Open SSL, Mozilla
- Jackpot metrics to Netbeans
- JFluid
- Electric













### 🛞 NetBeans

#### Tools

- RADAR Demand Forecasting Tool Set to WWOPS
- Electric CAE Design Tool
- IC CAD tools
- System Performance modeling and analysis

#### Code

- Java<sup>™</sup> and Java<sup>™</sup> KVM
- Hot Spot
- Java Speech API
- Parallel Garbage Collection
- Java make Utility to Netbeans
- Secure KVM to Java SW
- Jackpot JavaDoc extensions to JDK

#### **Standards and Protocols**

- Digital Rights Management DReaM
- Java Real-time extensions, JSR1
- Service Location Protocol













### **Thank You!**

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