How can Hardware Design Benefit from Open Source?

Jacob A. Abraham
The University of Texas at Austin
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http://www.cerc.utexas.edu/~jaa/

This presentation was developed and is presented using Open Source Software running on an Open Source OS

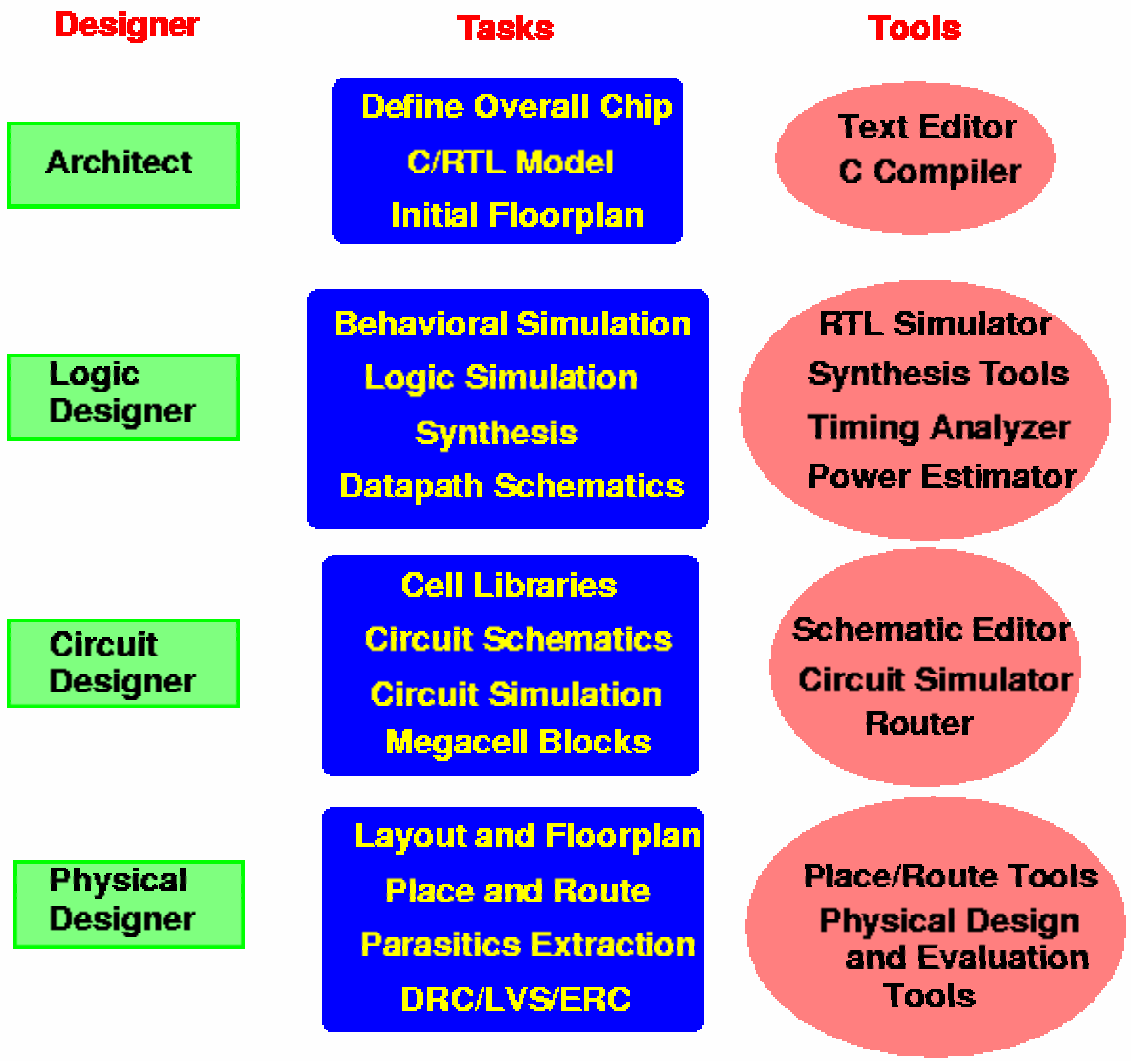
What Does Open Source Mean in Hardware?

- Ability to view design details
  - RTL
  - Library details
  - Example, SUN PicoJava, microSPARC cores
- Ability to use freely
  - Open Cores

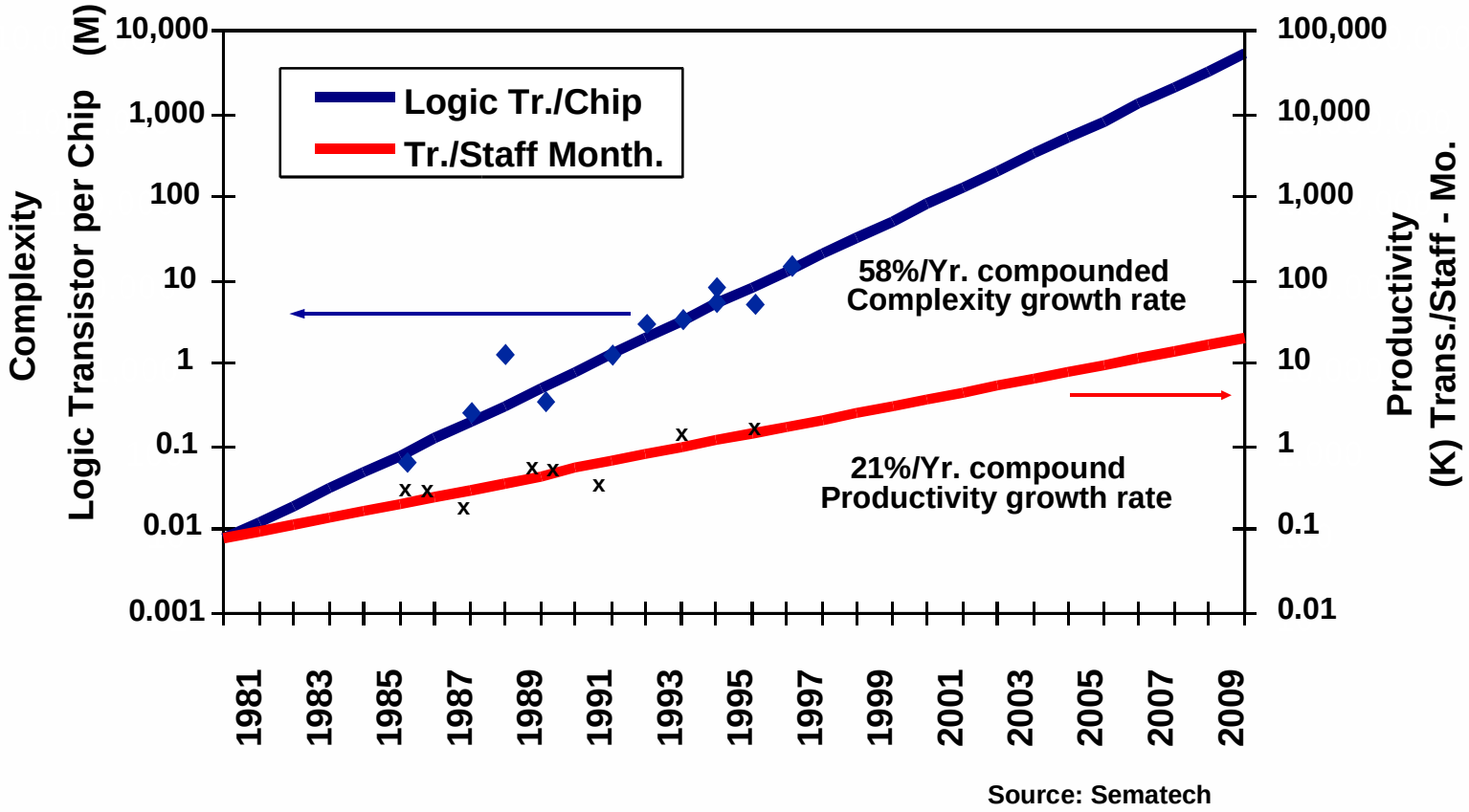
Hardware Design and Manufacture

- Involves
  - Design Tools
  - Collaboration
  - Libraries
  - Verification
  - Test
- Key issues:
  - Time to market/**volume**
  - Design team, costs

Hardware Design Steps



Productivity Trends



Courtesy, ITRS Roadmap

Complexity outpaces design productivity

Design Tools

- Basic Computer-Aided tools for design
  - Tools at various levels (layout, schematic, gate, RTL, system)
- Most are proprietary
  - Synopsys, Cadence, Mentor Graphics, Magma
- Run only on Unix-like platforms
  - Solaris
  - Linux
- Open CAD Tools are beginning to be developed

Reuse of Hardware Blocks

- One way to deal with design complexity and reduce time to market/volume
  - Reuse Intellectual Property (IP) cores
- Small companies rely on this to large extent
- Examples:
  - Memory blocks
  - Memory Built-In Self Test
  - Processor cores (ARM -- not open source!)
  - High-speed I/O cores

OpenCores.Org

- Many cores being designed and placed in open source
- www.opencores.org

Verification of Cores

- A major problem
  - Bugs in IP blocks
  - Marketing personnel will promise anything!
- How can we verify something we cannot see in detail?
- Verification is very difficult because of state-space explosion
- Need to examine critical operating modes in great detail

Other Design Tools

- Scripting tools needed to manipulate outputs of design tools, etc.
  - Translate from one format to another
- **Perl** is widely used by designers
  - Called the "glue of the Internet"
  - Also called the "duct tape of the Internet"
- "Most useful course" - engineers at very large semiconductor house

Collaboration Tools

- "Wiki"-like tools are becoming popular
  - Means "quick" in Hawaiian
- Example:
  - www.twiki.org

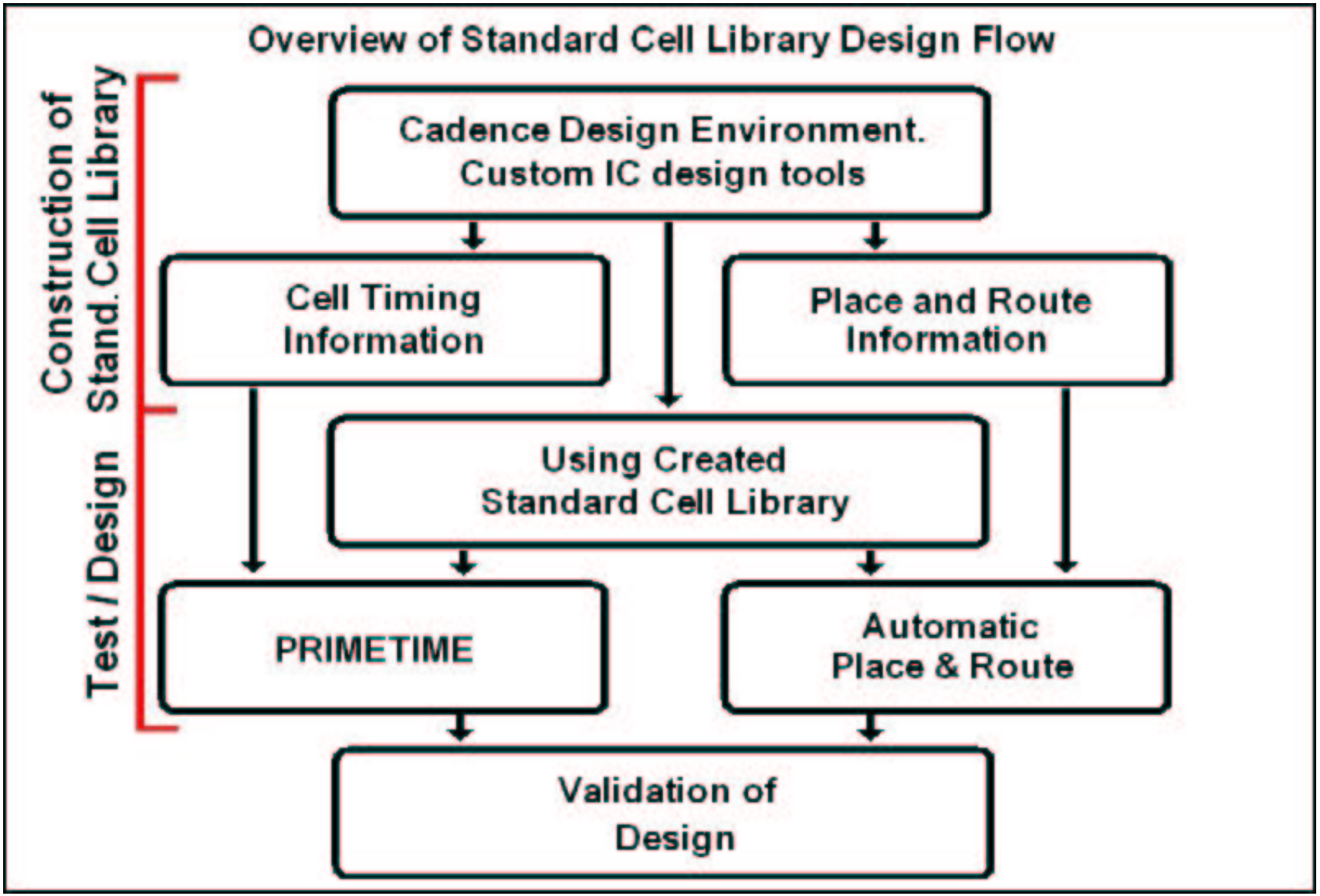
Other Tools With High Impact

- SPICE
  - Circuit simulation program placed in open source by Berkeley
- GCC
  - GNU C compiler for tool development
- Apache
  - Web server with more installations than all other web servers combined
- GIMP
  - Image manipulation tools

Open Source Libraries for IC Design

- Project at University of Texas
  - 0.18 μ library
- Commercial libraries have restrictions, require NDAs
- All views needed to
  - Design schematics
  - Static Timing Analysis
  - Synthesis
  - Automatic Place and Route
- Interest from universities, even CAD companies

Overview of Library Design Flow



Low Cost Consumer Products











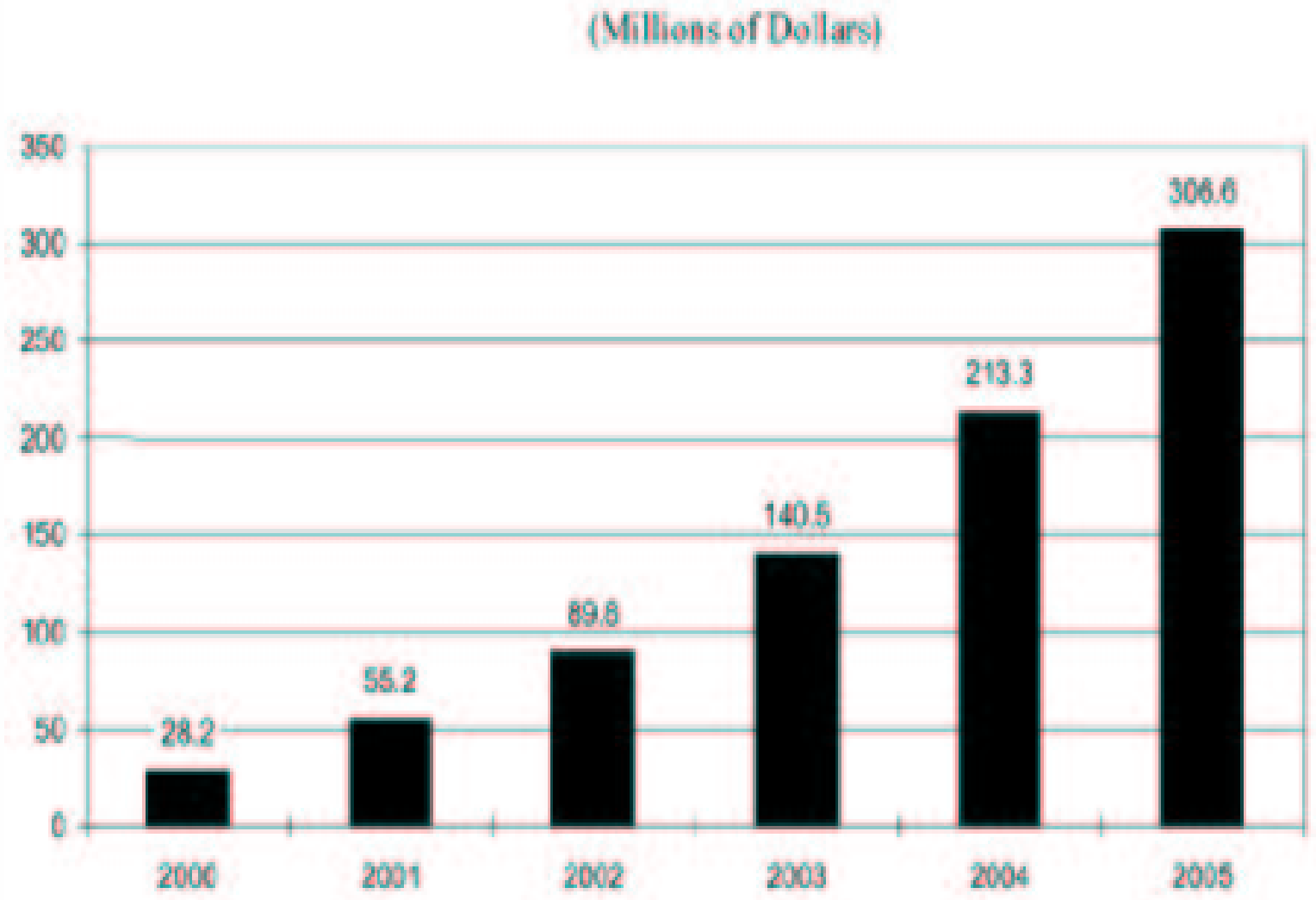



Cost of OS is a Key Driver

- Operating system costs are becoming a significant portion of low-cost Pcs
  - PCs selling for $199 have to use Open Source software to enable a profit
- Issue is even more crucial for embedded systems
  - PDAs
  - Mobile Phones
  - Robots

Linux in Embedded Systems

Worldwide shipment of Embedded Linux OSs, Software Development Tools and Services (Source: VDC)



Examples of Linux PDAs

Sharp Zaurus
IBM middleware
Sprint wireless

Sharp Zaurus
Intel StrongArm
Qt, Java runtime

Royal LineaLX
Motorola Dragon-Ball processor

G.Mate Yopy
Email (mobile)
MP3, MPEG,...

IBM e-LAP
Power PC
J2ME VM

Q-Reader
Ebook
(China)

HNT Exilien
Two models
StrongARM

SK Telecom
Webphone
Qt, Opera

Linux-Based Mobile Phones

Samsung Smartphone XScale proc.

E28 (China) PDA, camera handwriting

Motorola A760 Java, PDA, MP3, camera, video, BT

Telepong (tweens market), GPRS, camera, games

Wildseed (teen market), Xscale processor

Galileo PDA,web appliance, mobile (GSM/GPRS)

Zultys IP phone voice encryption, 5-way conference

Innomedia IP Videophone

Linux-Based Robots

ActivMedia Patrolbot
Surveillance
Laser, Sonar, bump sensors

Wakamaru, 1 m tall
Companion, house sitter, 10,000 word vocabulary, face recognition

Smart Robots SR4 autonomous mobile robot

Isamu 53" tall, climbs stairs, face recognition dual Pentium "brain"

Fujitsu HOAP 1, research vehicle

NASA Personal Satellite Assistant, P-III, for space shuttle and Int'l Space Stn.

Different Culture of Open Source

- Illustrate with a story
- Larry Wall, developer of Perl, got a call some years ago
  - "We are a startup called *Yahoo*, and we would not be where we are without Perl"
  - "We are going public soon, and want to give you some pre-IPO stock"
- Normal culture is:
  - If we don't have a contract (or we are much bigger than you), we will do what we want with the software

Future of Open Source?

- *'Prediction is extremely difficult, especially about the future' -- Niels Bohr*
- Con Zymaris (2003) says it is inevitable that open source will dominate
  - Http://www.cyber.com.au/users/conz/shoulders.html
- Analogy with **Science**
  - Process of verifying or culling hypotheses
  - Open, self-correcting system
- *'There is one thing stronger than all the armies in the world, and that is an idea whose time has come' -- Victor Hugo*