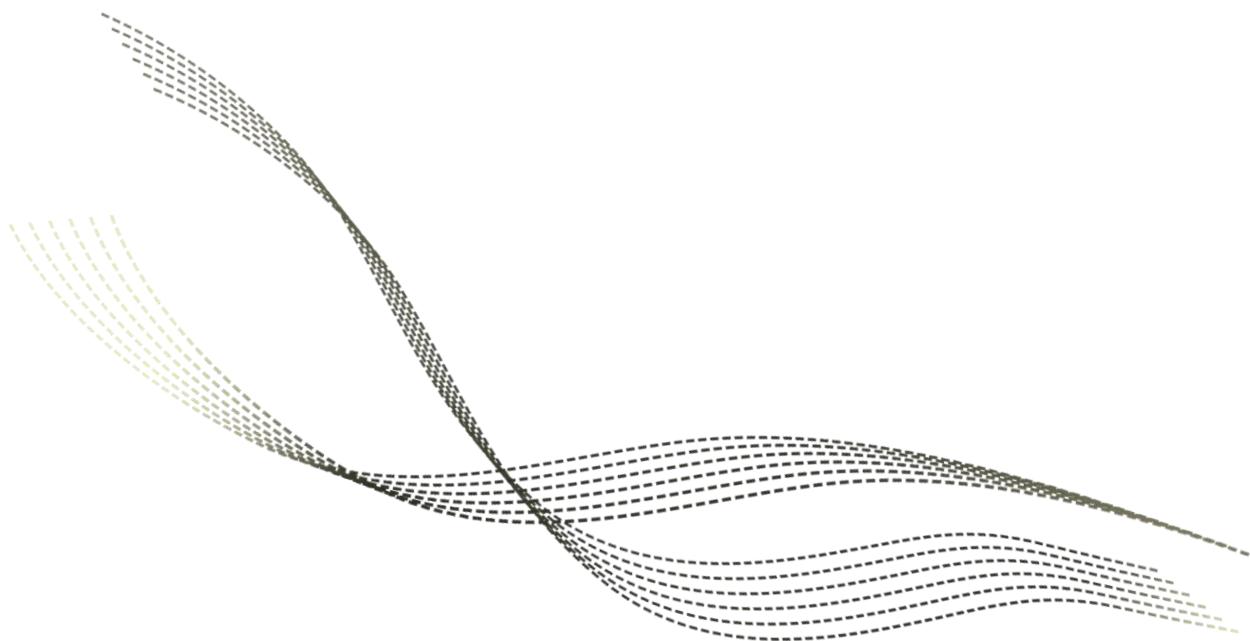


# 高级计算机体系结构

Advanced Computer Architecture

集成电路设计流程

沈明华



# 目录

CONTENTS

01

芯片设计

02

数字流程

03

模拟流程

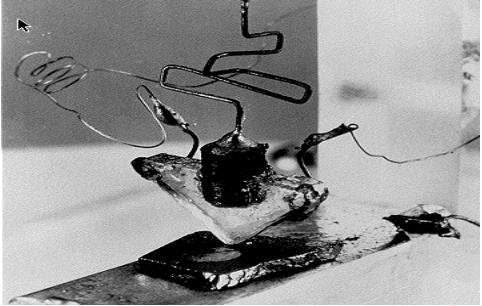
04

总结思考

# PART 01

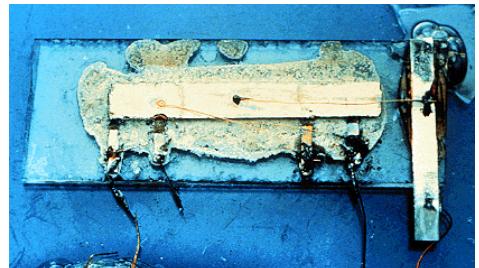
## 芯片设计

# ■ 半导体历史



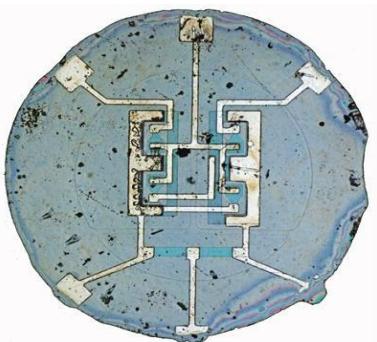
First Transistor

Bell Labs 1947



First IC

TI 1958



First Planar IC

Fairchild 1960



Julius Blank

Victor Grinich

Jean Hoerni

Eugene Kleiner

Jay Last

Gordon Moore

Robert Noyce

Sheldon Roberts

# ■ 半导体商业

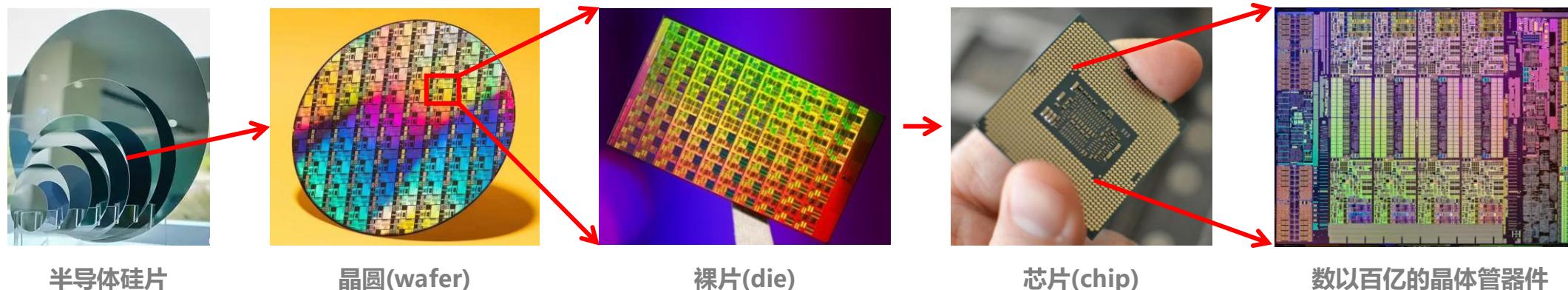


# ■ 集成电路芯片

**芯片：将电子器件在半导体衬底上集成以实现特定功能的集成电路**

- 器件：尺寸越小越好 (微米级→纳米级→量子级)
- 芯片：集成规模越大越好

**当前产业水平：芯片级集成密度 $1.7\text{亿}/\text{mm}^2$ 、590亿晶体管  
晶圆级集成2.6万亿晶体管**



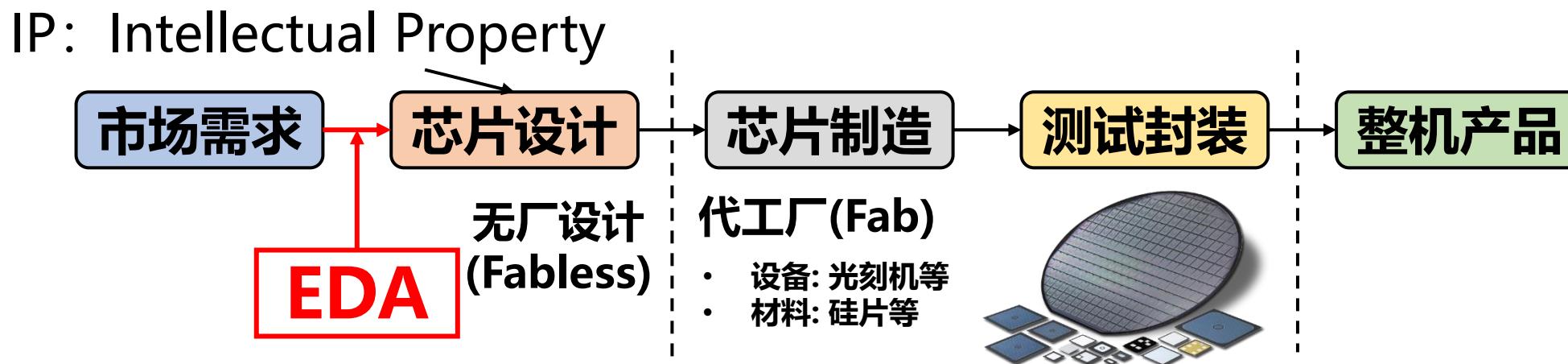
# ■ 芯片与芯片设计

口芯片包括设计、制造、封测以及上游的EDA软件、IP核等产业

口电子设计自动化软件EDA： Electronic Design Automation

- 面对亿级、百亿级晶体管单元，人工手动设计难以实现
- 需要EDA软件技术辅助人们自动完成复杂的芯片设计
- 是支撑芯片产业发展的基础

无论是设计、制造还是封测，都需要EDA技术支撑



# ■ 芯片设计：手动-自动-智能

阶段一  
1950-1980

艺术设计  
设计者手工设计  
版图与规则检查

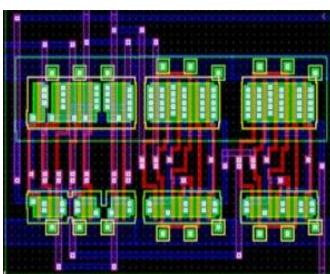


无CAD  
完全手工制定

AI程度

阶段二  
1980-2000

辅助设计  
设计者使用有限  
布局布线工具



简单  
CAD/CAE工具

1981 Mentor  
1986 Synopsys  
1988 Cadence

阶段三  
2000-2020

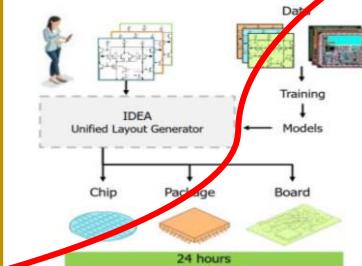
自动设计  
设计者使用参数  
调整不断优化性  
能指标



专业EDA工具  
大规模与高PPA

阶段四  
2020-2040?

智能设计  
设计者定义设计  
和AI优化完成



AI赋能  
EDA软件

2017-2022 DARPA ERI IDEA  
(No Human in Loop)

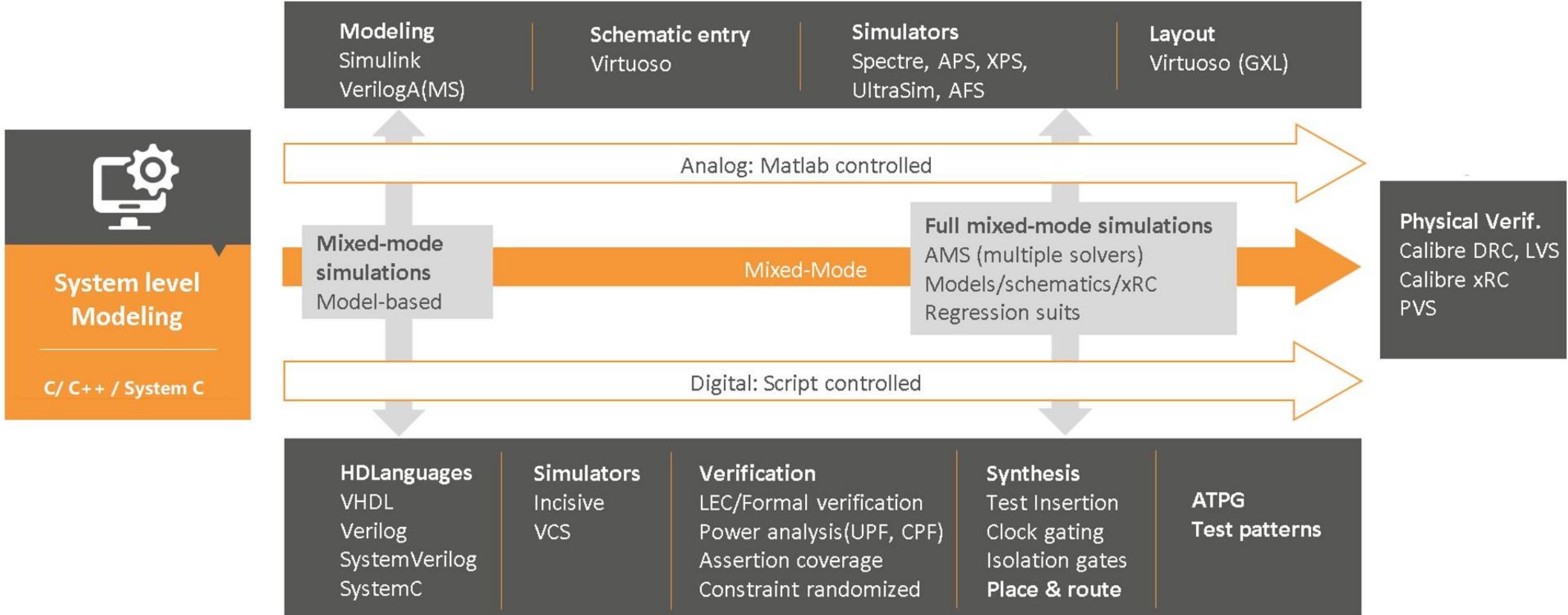
阶段五  
?

AI设计  
没有设计者参与  
设计(No human  
in design)



AI驱动AI优化  
EDA软件

# ■ 芯片设计流程一般视图

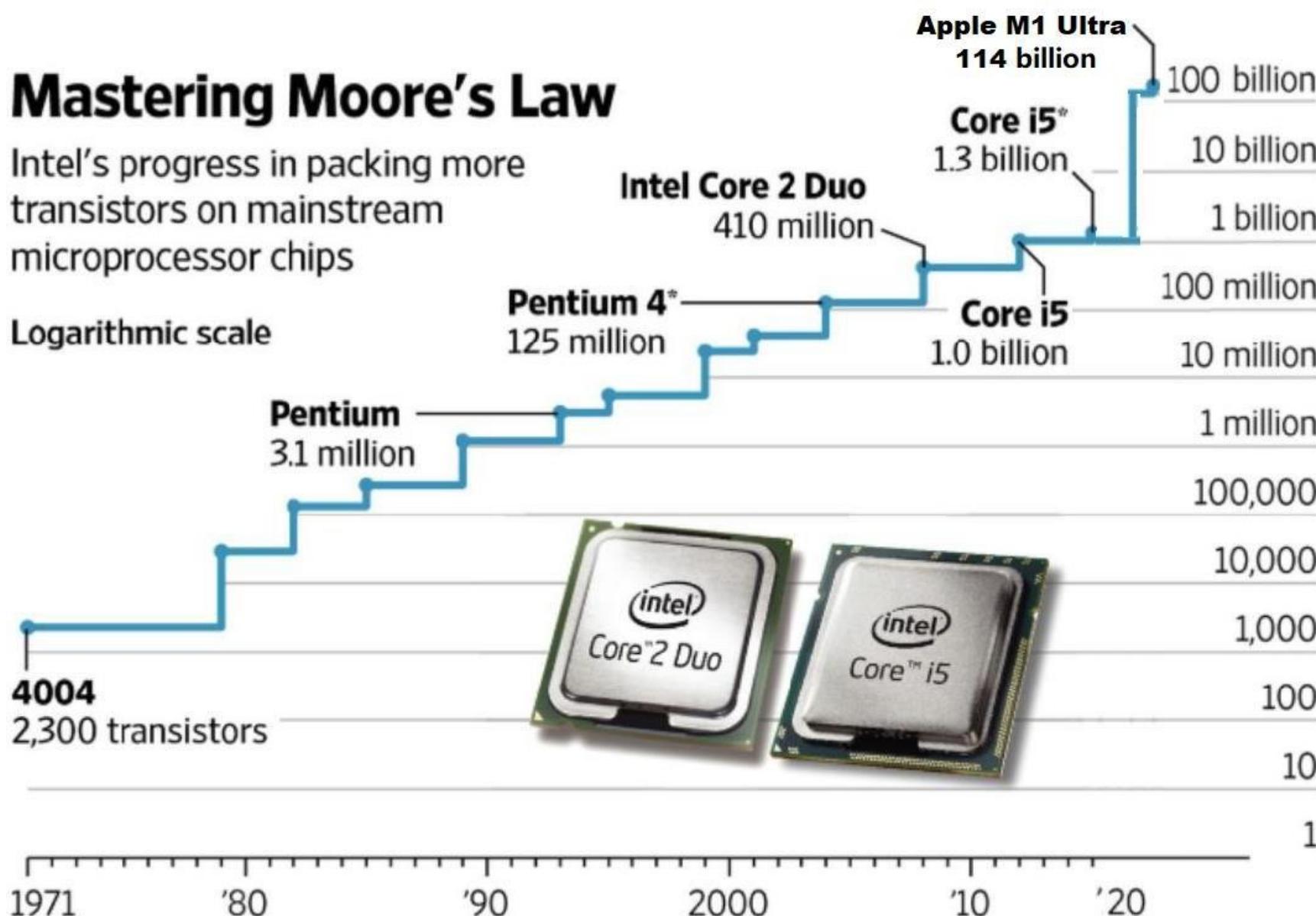


## ■ 芯片集成规模日益增长

### Mastering Moore's Law

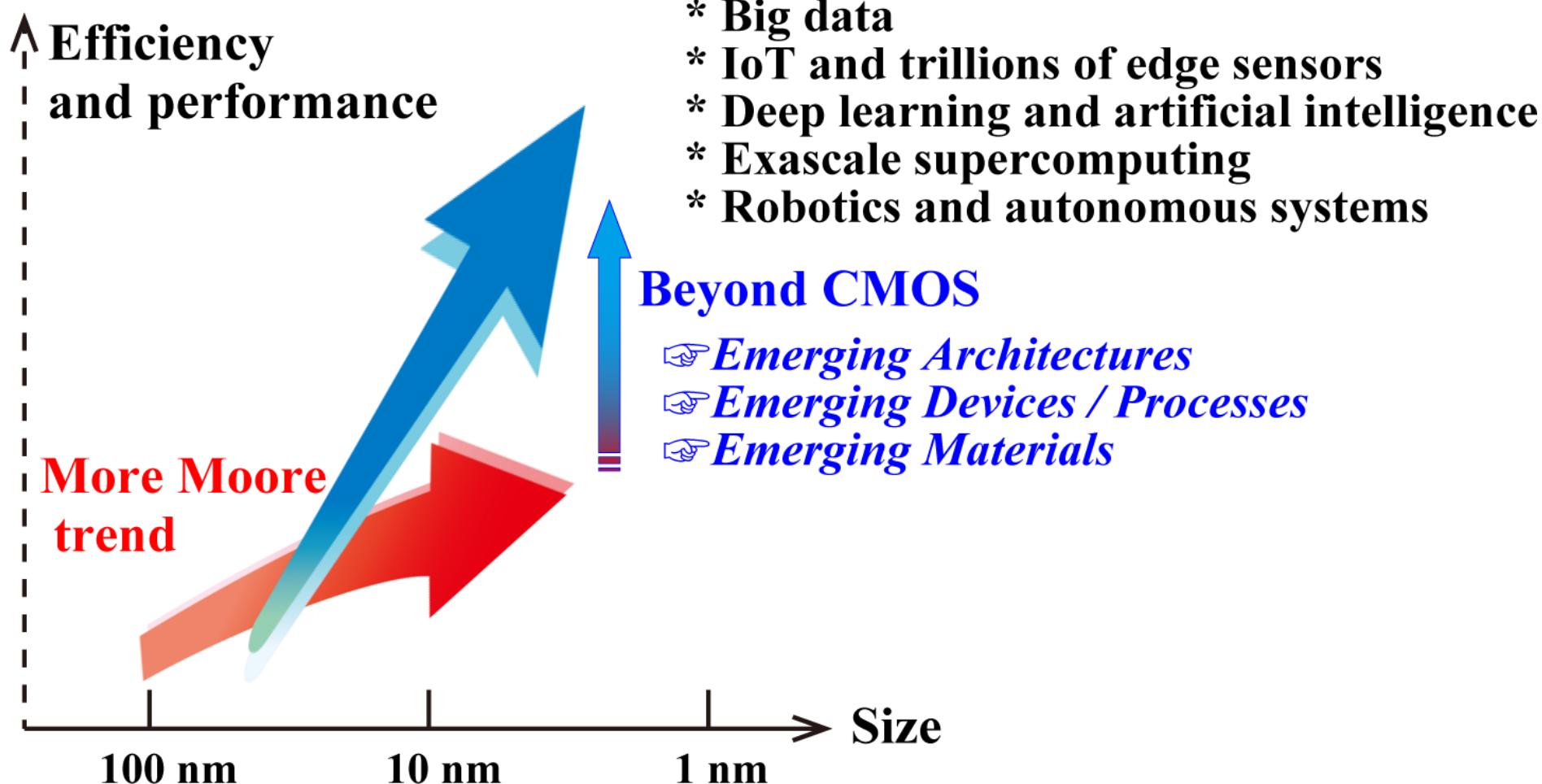
Intel's progress in packing more transistors on mainstream microprocessor chips

Logarithmic scale

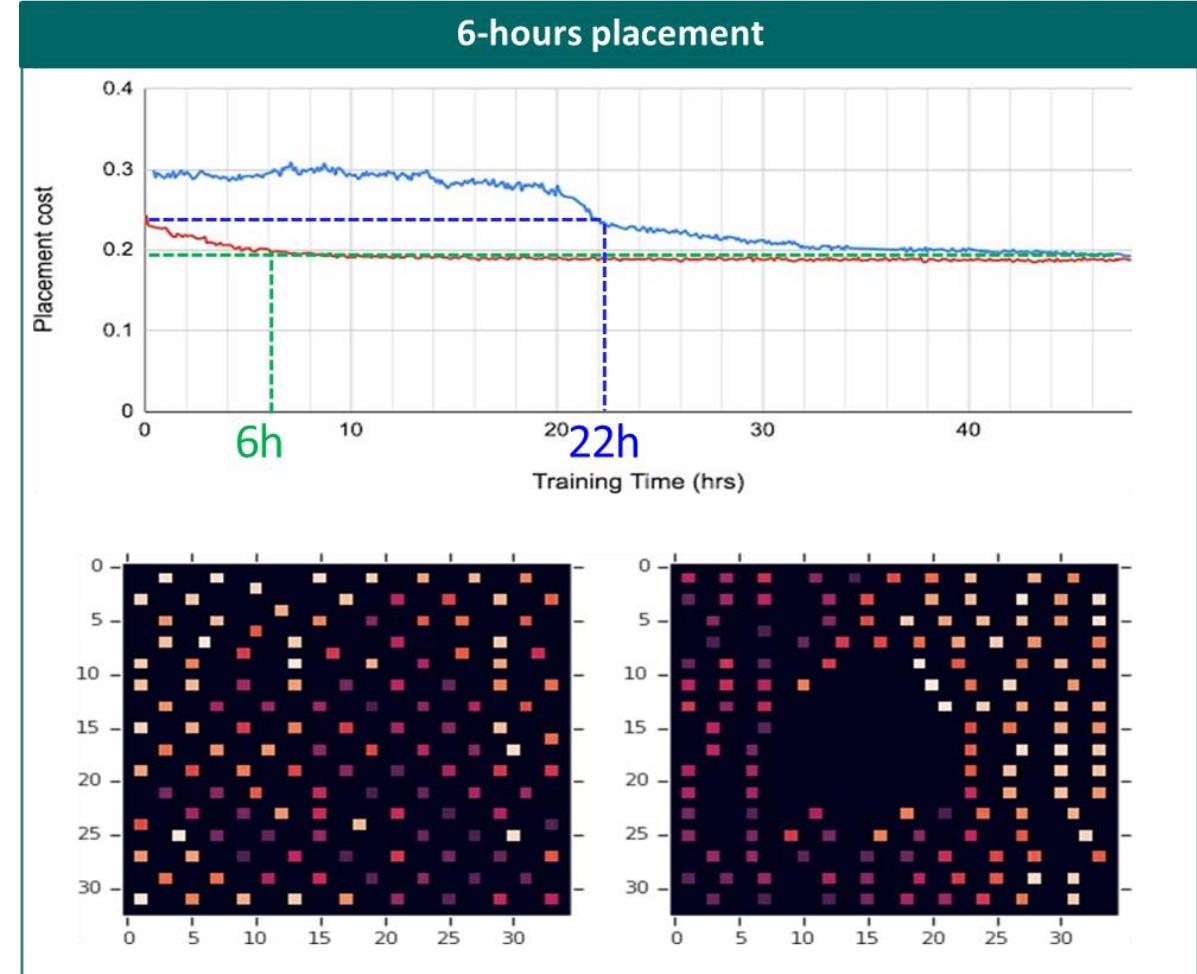
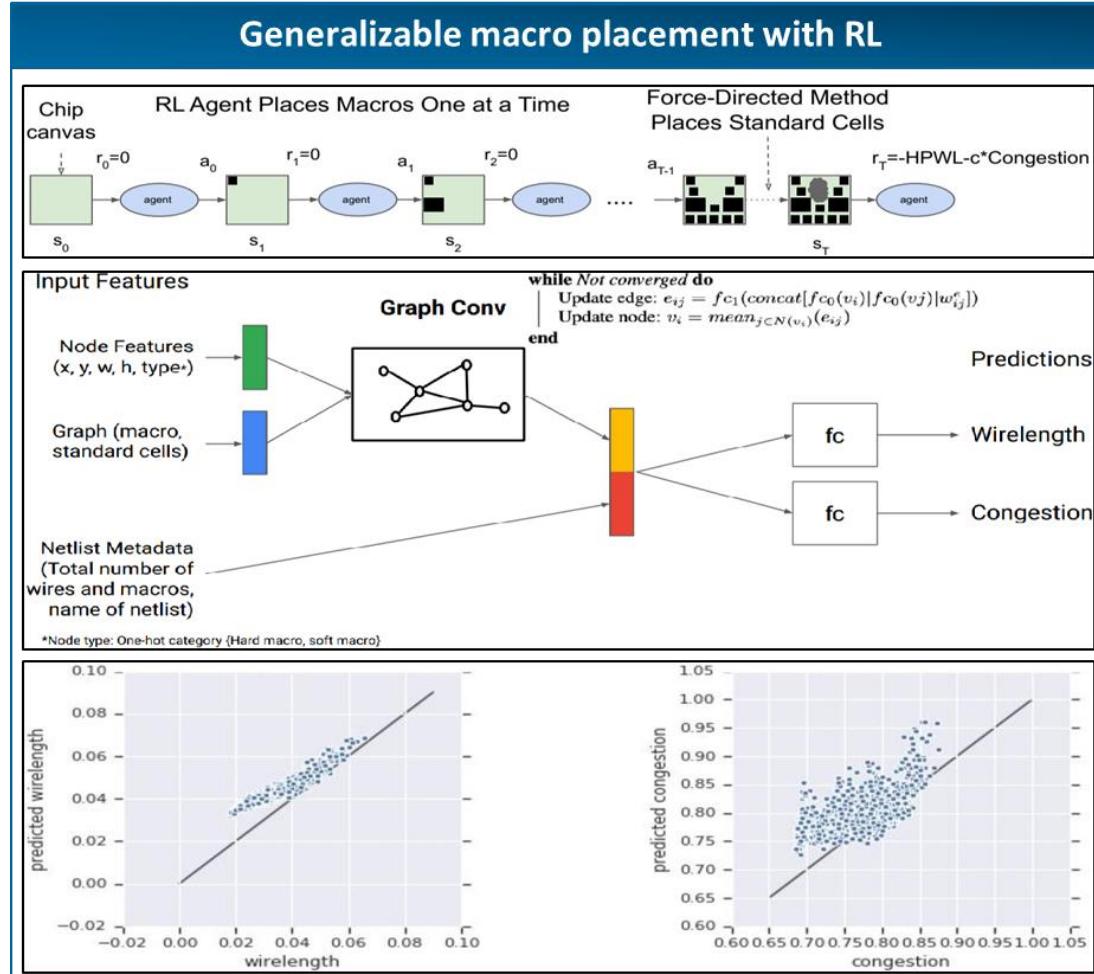


## ■ 芯片设计效率越来越低

### Novel computing paradigms and application pulls

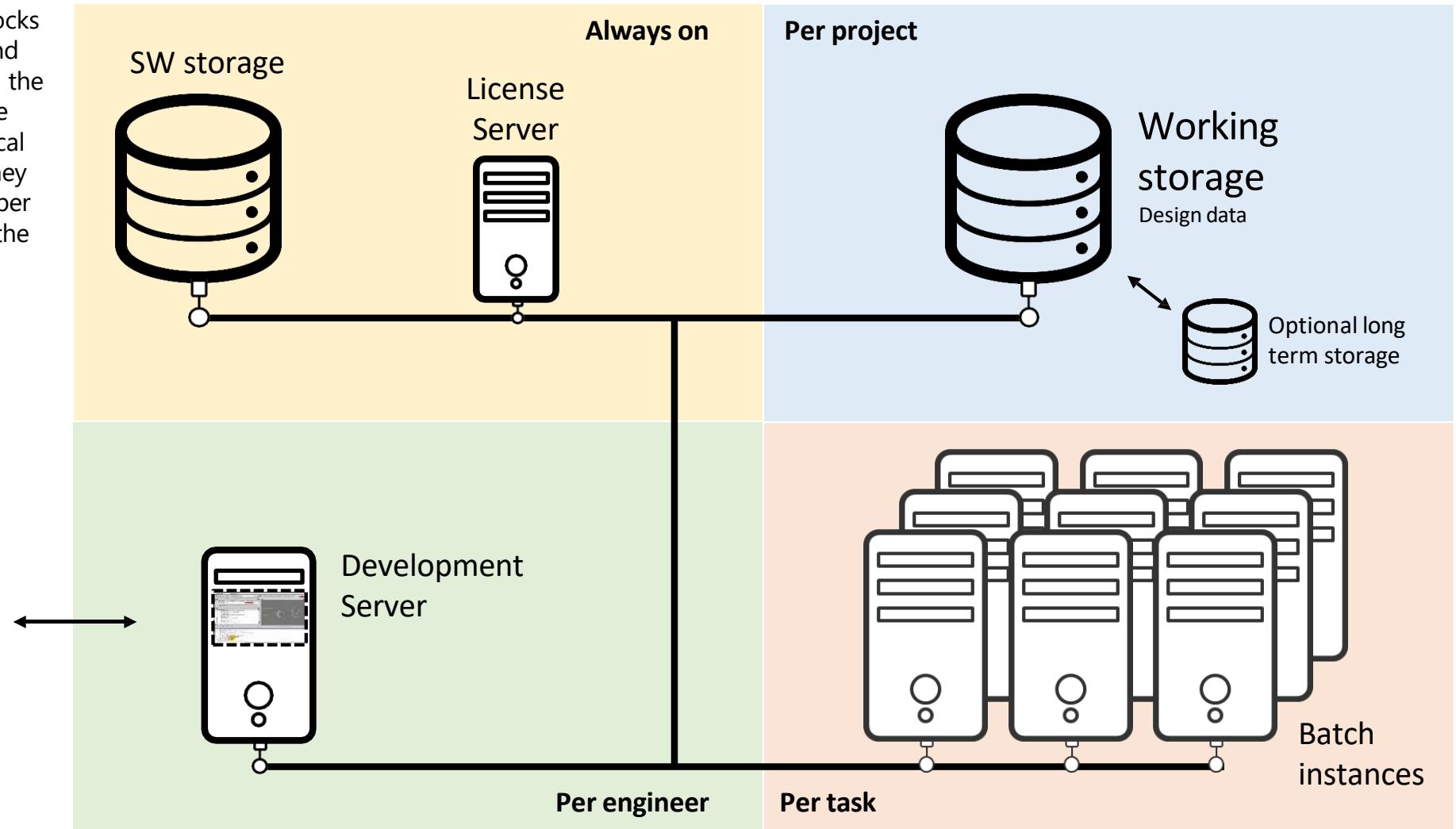
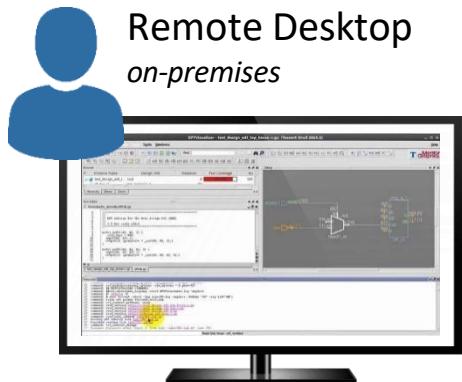


# ■ 人工智能设计芯片: Google RL-based Placement

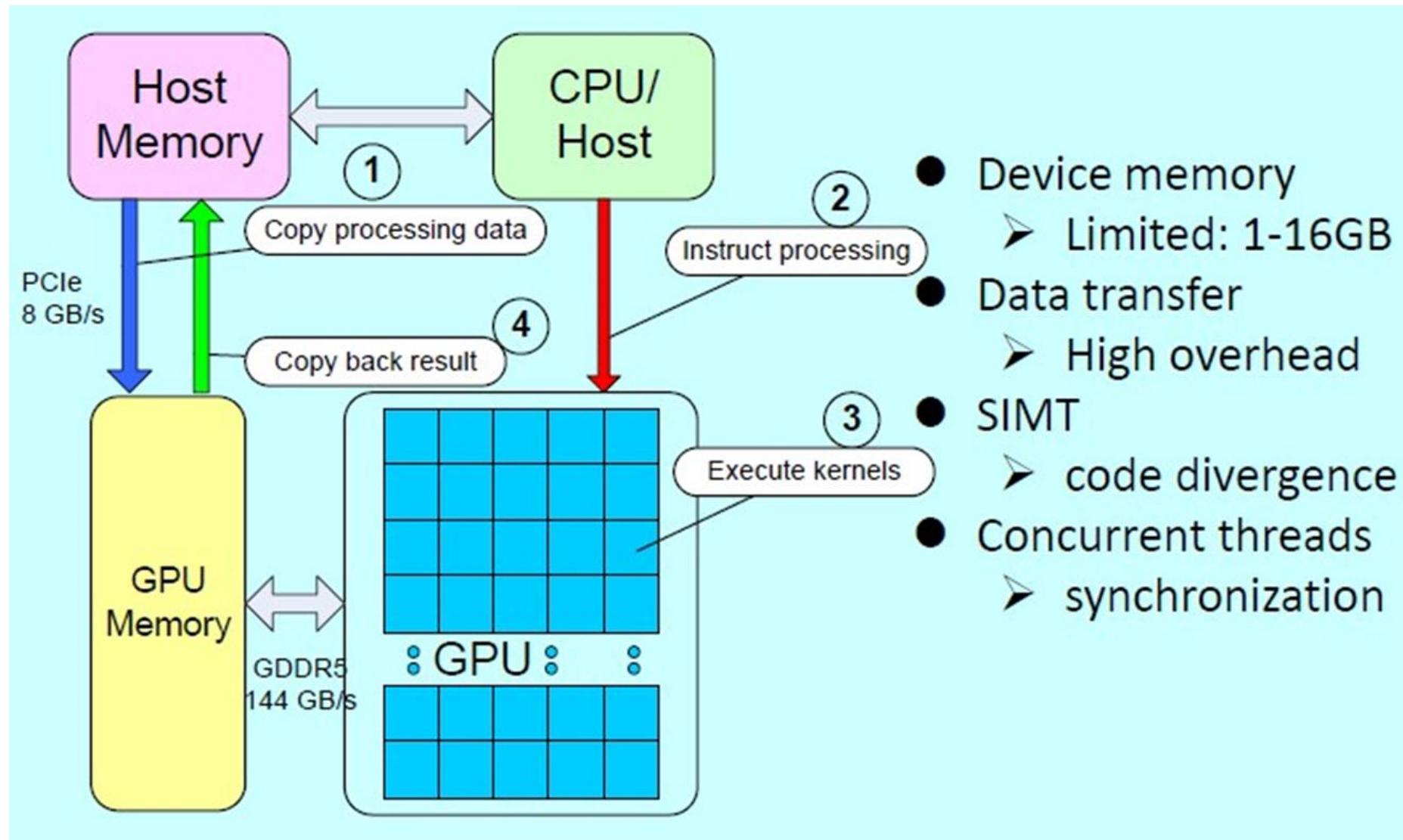


# ■ 云上芯片设计: Faster Time to Market

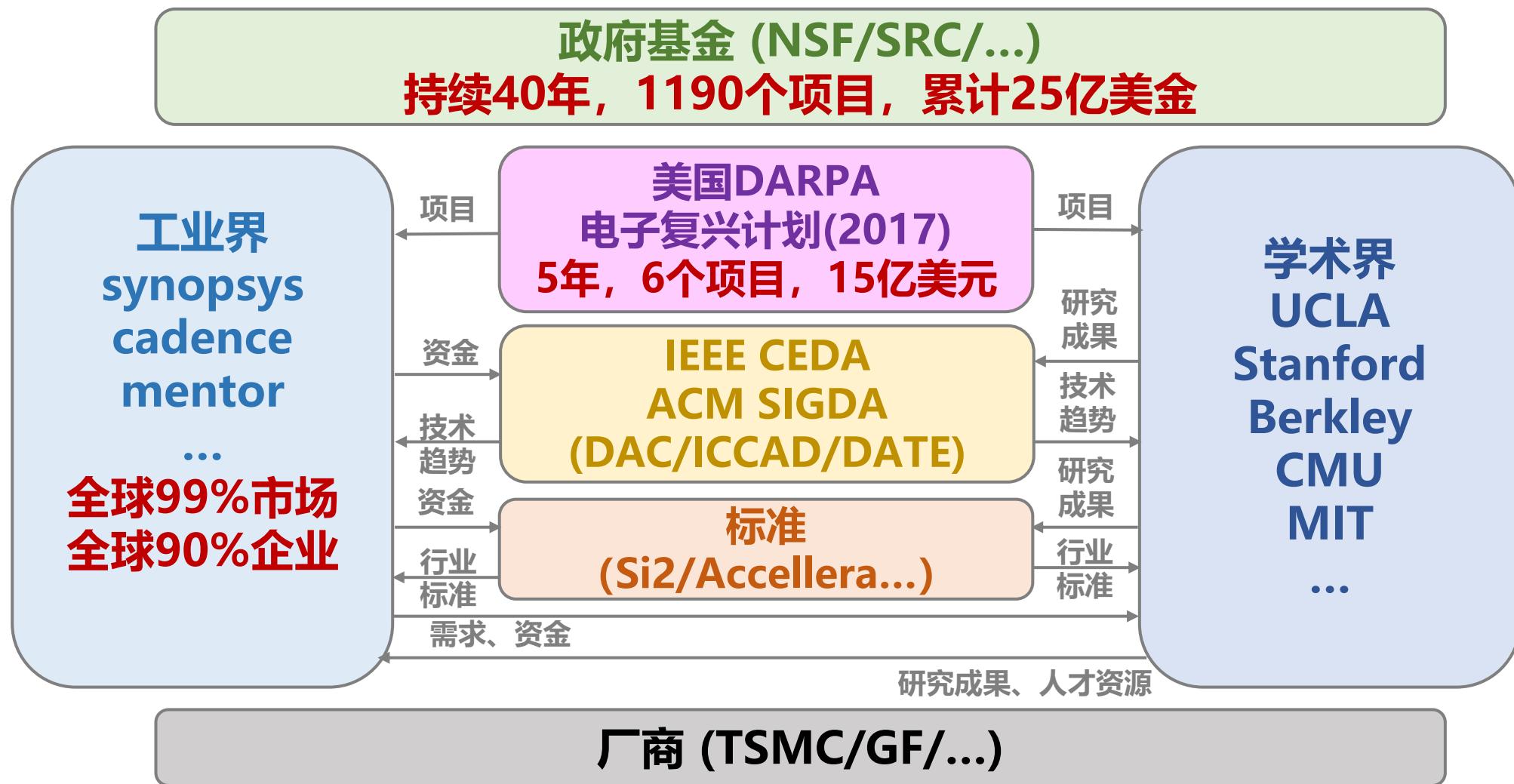
The ability to bypass internal roadblocks to adequate computing resources and access much larger resource pools in the cloud enables teams to compress the total time it takes to complete physical verification, simulation, fill, etc., so they can perform more design iterations per day and actually get designs out to the market faster. [1]



# ■ 基于异构计算的芯片设计



# ■ 政府、工业、学术三方合作(以美国为例)



**感谢！**

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