

Accelerating Innovation

In the Era of Exponentials

Dr. Chi-Foon Chan

President and co-Chief Executive Officer, Synopsys, Inc.

August 27, 2013

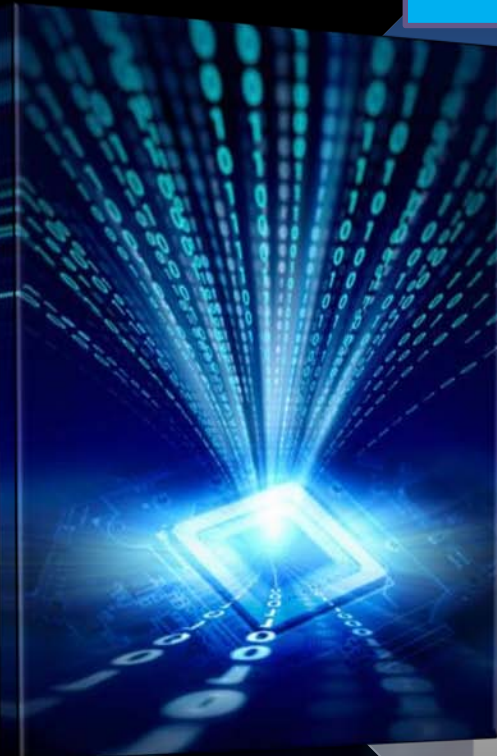
Accelerating Technology Innovation

Exciting time to be an Engineer

The Era of Electronics

Technology

The Future Ahead



SYNOPSYS®

Accelerating Innovation

\$1.76B FY12 Revenue

~84 Offices Worldwide

~8,195 Employees

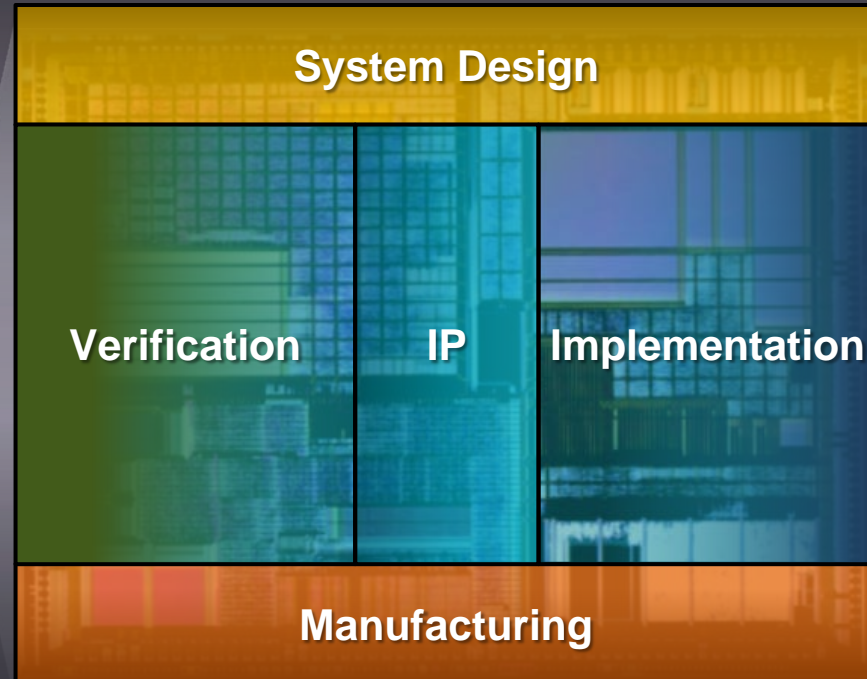
~4,431 Masters/
PhD Degrees

~31% R&D/Revenue

~5,129 R&D Engineers

~1,100 Application
Consultants

~1,889 Issued Patents



Advanced Technology Leadership Delivers Benefits at Every Node

What Happens in



639,800 GB of global IP data



204 Million
Emails Sent



>2 Million
Search Queries



6 Million
Facebook Views



1.3 Million
Video Views

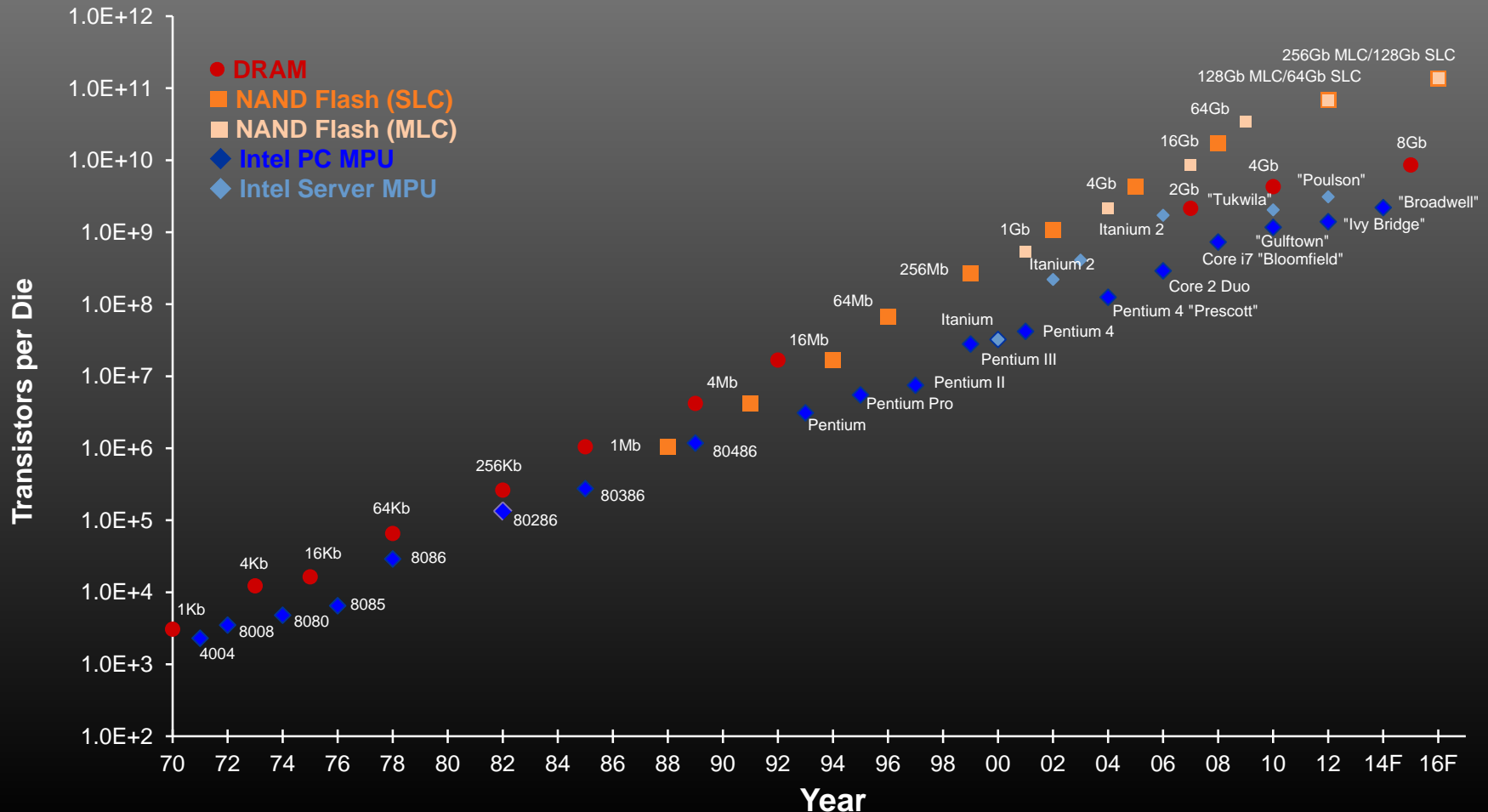
And the Future Growth is Exponential

Today, the number of networked devices =  the global population

By 2017, the number of devices connected to IP networks will be **3x** as high as  the global population

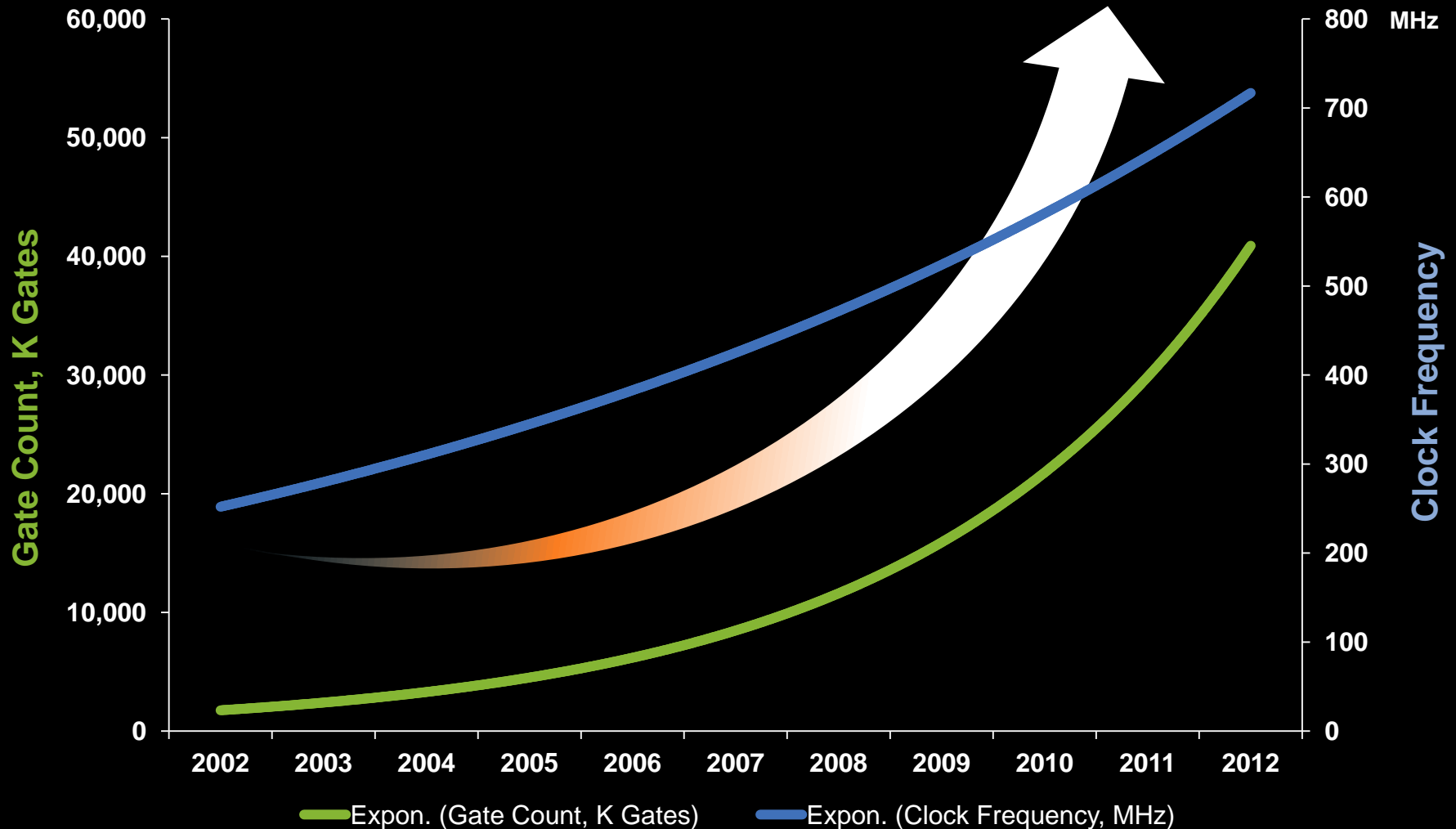
Moore's Law Continues...

Transistor Count Trends



Source: Intel, SIA, IC Insights 2012

Designs Are Larger and Faster

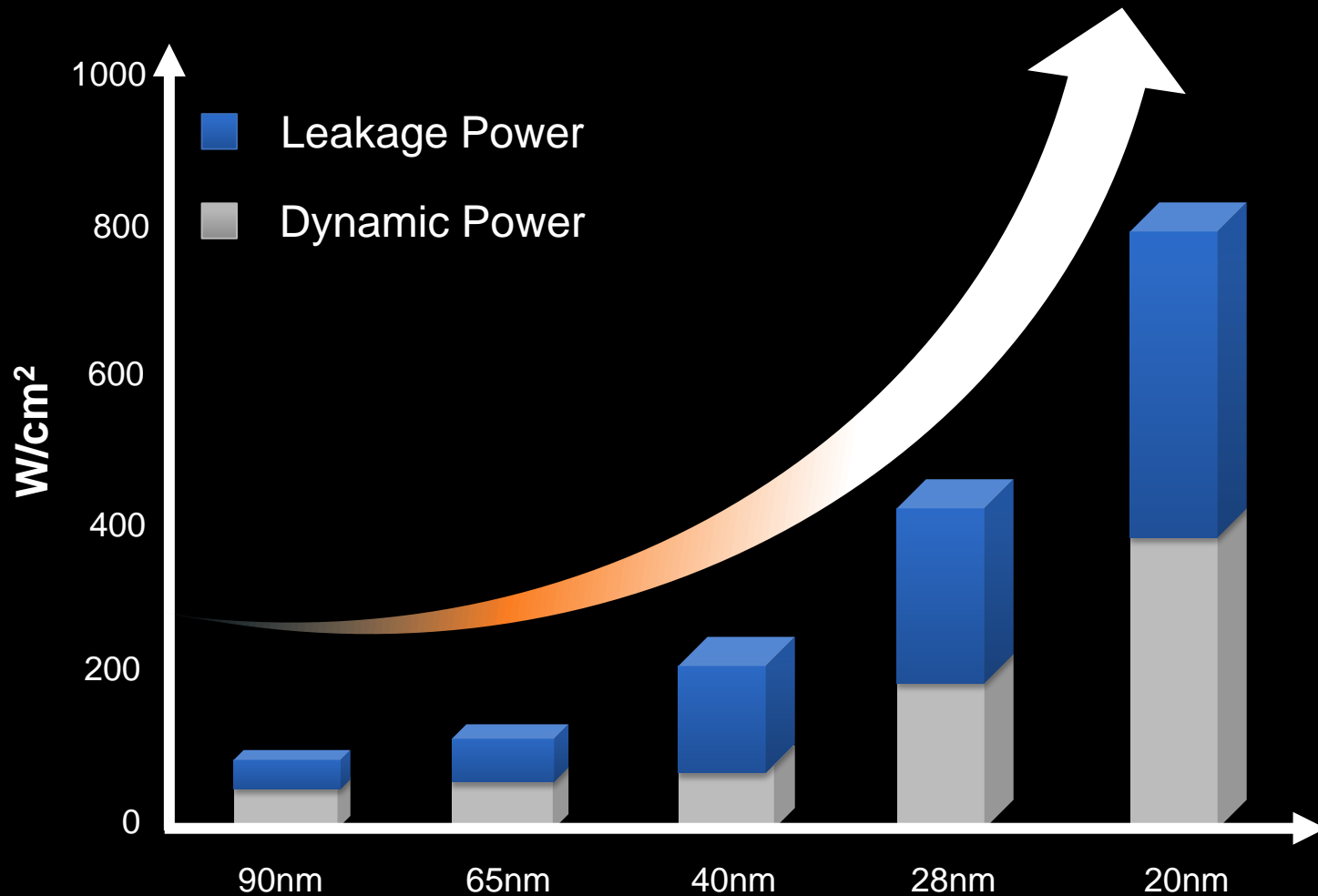


Source: Synopsys Global User Survey, 2002-2012

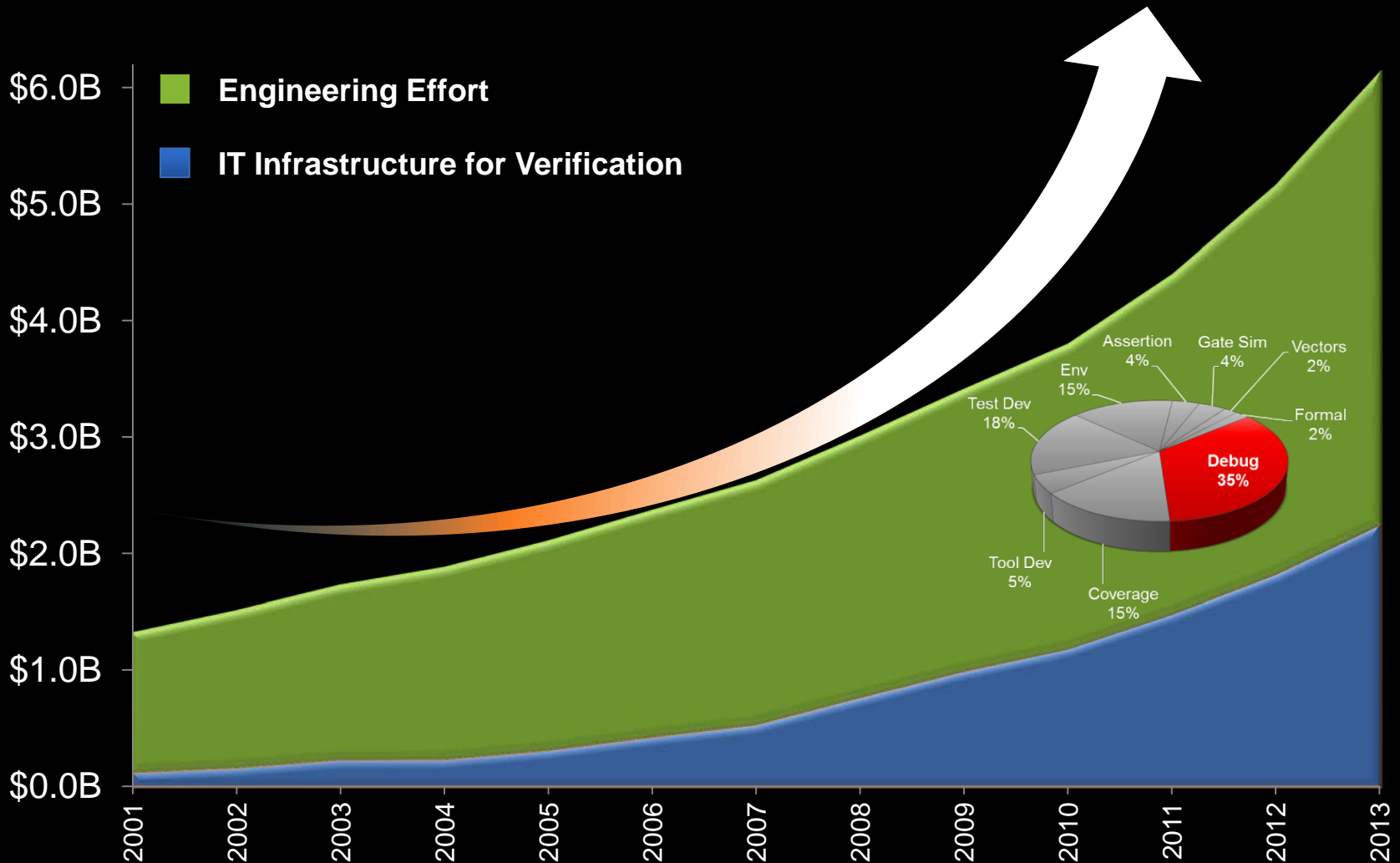
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ASQED

Power Is a Growing Problem

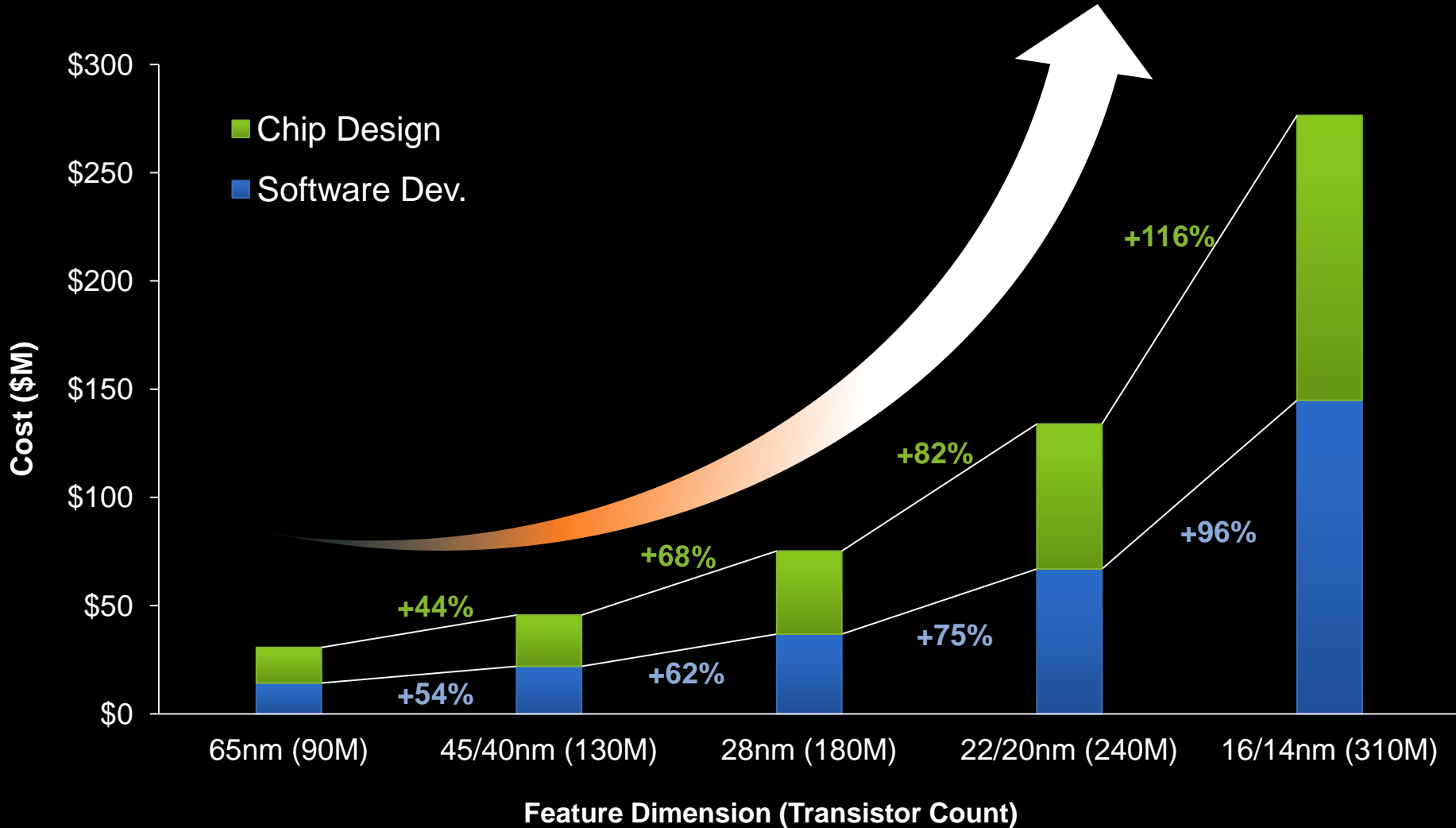


Functional Verification Costs Are Exploding

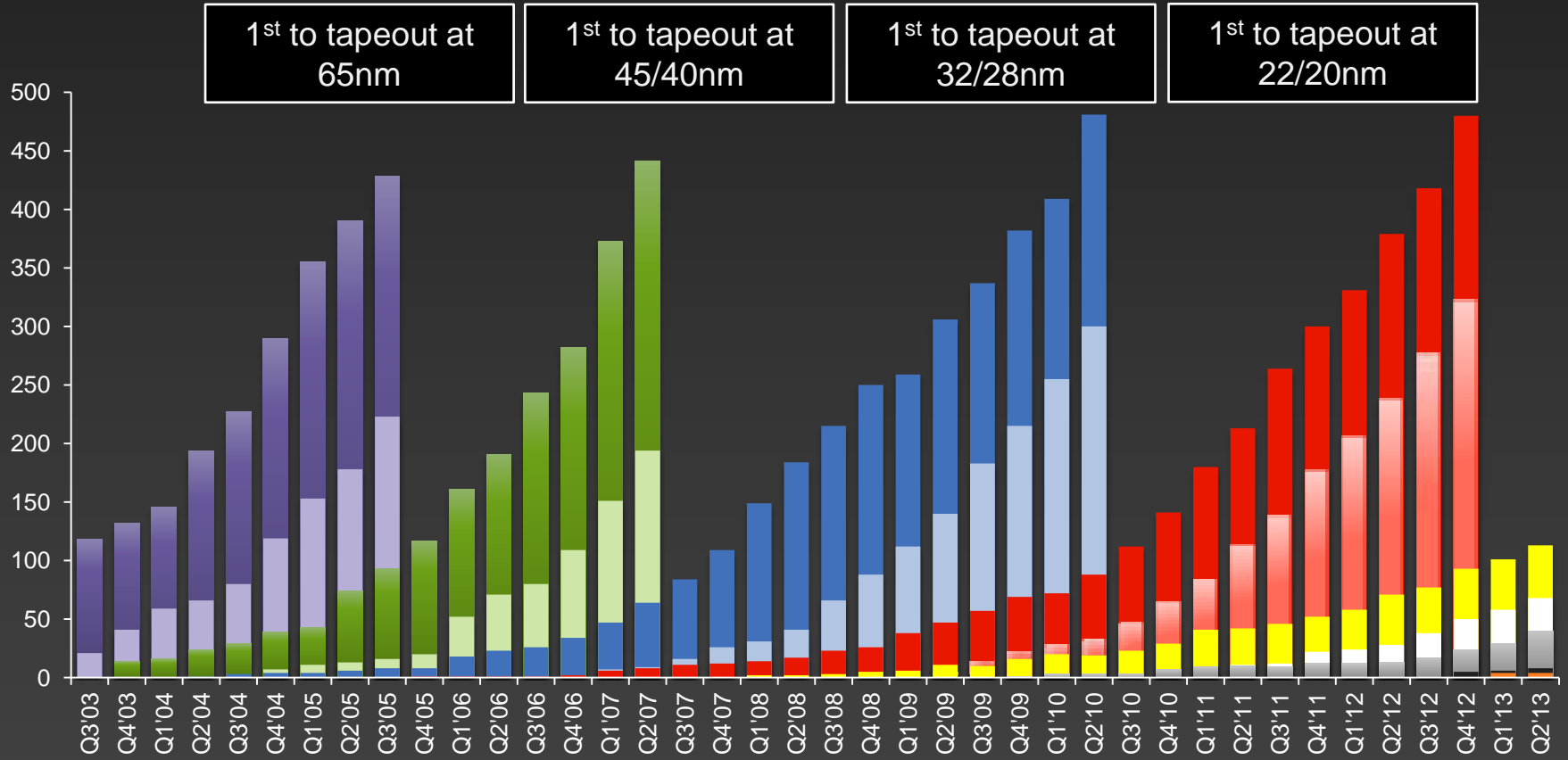


Source: VCS User Companies, Synopsys
© Synopsys 2013
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Chip Development Costs Are Increasing



Advanced Designs at Every Node



Advanced Tapeout Counts

90nm

65nm

45/40nm

32/28nm

22/20nm

16/14nm

10nm

Companies Working Hard to Differentiate

Recession

Recovery

Uncertainty

			08				09				10				11				12								
			CY08				CY09				CY10				CY11				CY12				CY13				
LFY Rev	Customer		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2		
\$188B	Samsung	Results																									
		Outlook																									
		Economy																									
\$53.3B	Intel	Results	!	/	+	/	-	++	++	++	++	++	++	++	!	+	++	+	++	+	+	!	!	!	!	!	
		Outlook	!	/	+	!	-	/	+	++	++	++	++	++	++	+	++	++	+	+	+	+	+	+	+	+	!
		Economy	/	+	/	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$19.1B	Qualcomm	Results	/	+	+	++	+	+	+	/	/	+	+	++	++	++	+	++	++	!	++	++	++	++	+	+	
		Outlook	/	+	+	+	++	+	+	+	!	!	+	++	++	++	++	++	++	!	+	++	++	++	+	+	+
		Economy	/	+	+	+	+	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$17.1B	TSMC	Results	/	/	/	/	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
		Outlook	/	+	!	!	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	!
		Economy	!	/	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$12.8B	Texas Instruments	Results	+	/	+	/	-	++	++	++	++	++	++	++	!	!	!	!	!	!	!	!	!	!	!	!	
		Outlook	/	!	-	-	+	+	+	+	+	+	+	+	+	!	!	!	!	!	!	!	!	!	!	!	!
		Economy	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$8.5B	STMicro	Results	/	+	+	/	-	+	+	/	+	+	+	+	/	!	!	!	!	!	!	!	!	!	!	!	
		Outlook	!	+	+	!	-	+	+	+	+	+	+	+	!	!	!	!	!	!	!	!	!	!	!	!	
		Economy	/	+	+	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$8.2B	Micron	Results	-	-	-	-	!	-	/	+	++	++	++	+	-	+	+	+	!	-	!	!	!	-	++	+	
		Outlook	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
		Economy	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$8B	Broadcom	Results	+	+	++	++	+	+	++	++	++	++	++	++	+	++	++	++	++	++	++	++	++	++	++	++	
		Outlook	/	++	/	!	+	+	+	!	+	++	+	+	/	!	+	+	+	+	+	+	+	+	+	+	
		Economy	/	+	+	!	+	+	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$5.4B	AMD	Results	/	-	-	++	-	+	/	+	++	+	++	!	+	+	+	/	/	+	+	+	+	+	++	+	
		Outlook	/	-	-	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
		Economy	/	-	!	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!
\$4.6B	Freescale	Results					-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
		Outlook					-	/	+	+	+	+	+	+	+	!	!	!	!	!	!	!	!	!	!		
		Economy					-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
\$4.3B	NVIDIA	Results	+	!	-	++	-	++	++	++	++	+	-	/	+	++	+	+	+	+	+	+	+	+	+	+	
		Outlook	+	!	!	!	-	++	++	++	++	!	-	+	++	+	+	+	+	+	+	+	+	+	+	+	
		Economy	/	/	-	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
\$3.2B	Marvell	Results	+	+	++	+	-	+	/	++	++	+	+	+	+	!	!	!	!	!	!	!	!	!	!		
		Outlook	/	/	++	!	-	+	++	++	++	++	++	++	!	-	+	+	+	+	+	+	+	+	+		
		Economy	/	/	!	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
\$2.2B	Xilinx	Results	++	!	+	/	-	++	!	+	++	++	++	++	!	-	++	!	++	+	+	!	!	!	!	++	
		Outlook	/	!	/	!	-	+	+	+	++	++	!	+	+	+	+	+	+	+	+	+	+	+	+		
		Economy	!	!	!	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	
\$1.8B	Altera	Results	++	++	++	+	-	+	/	+	++	++	++	++	+	+	+	+	+	+	+	+	+	+	+		
		Outlook	+	+	/	!	-	+	!	+	++	++	++	++	+	+	+	+	+	+	+	+	+	+	+		
		Economy	!	!	!	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!		
\$2.5B	LSI	Results	+	++	++	+	-	+	+	+	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
		Outlook	!	++	++	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
		Economy	/	!	!	!	-	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!		

1H13 Top 20 Semiconductor Sales Leaders (\$M, Including Foundries)

1H13 Rank	2012 Rank	Company	Headquarters	2012 Tot Semi	1H12 Tot Semi	1Q13 Tot Semi	2Q13 Tot Semi	1H13 Tot Semi	1H13/1H12 % Change
1	1	Intel	U.S.	49,114	24,296	11,555	11,785	23,340	-4%
2	2	Samsung	South Korea	32,251	15,101	7,952	7,771	15,723	4%
3	3	TSMC*	Taiwan	16,951	7,810	4,460	5,152	9,612	23%
4	4	Qualcomm**	U.S.	13,177	5,928	3,916	4,222	8,138	37%
5	8	SK Hynix	South Korea	9,057	4,406	2,577	3,521	6,098	38%
6	6	Toshiba	Japan	11,217	5,659	2,938	2,868	5,806	3%
7	5	TI	U.S.	12,081	6,077	2,718	2,922	5,640	-7%
8	10	Micron	U.S.	8,002	4,204	2,144	2,450	4,594	9%
9	9	ST	Europe	8,364	4,126	1,994	2,033	4,027	-2%
10	11	Broadcom**	U.S.	7,793	3,687	1,954	2,035	3,989	8%
11	7	Renesas	Japan	9,314	4,480	1,886	1,920	3,806	-15%
12	15	GlobalFoundries*	U.S.	4,560	2,340	1,240	1,325	2,565	10%
13	14	Infineon	Europe	4,928	2,564	1,208	1,327	2,535	-1%
14	16	NXP	Europe	4,325	2,053	1,085	1,188	2,273	11%
15	13	AMD**	U.S.	5,422	2,998	1,088	1,161	2,249	-25%
16	12	Sony	Japan	5,709	2,986	1,049	1,148	2,197	-26%
17	24	Elpida***	Japan	3,075	1,997	945	1,160	2,105	5%
18	22	MediaTek**	Taiwan	3,366	1,457	817	1,115	1,932	33%
19	20	UMC*	Taiwan	3,730	1,804	898	1,015	1,913	6%
20	19	Freescale	U.S.	3,803	1,892	917	988	1,905	1%
Top 10 Total				168,007	81,294	42,208	44,759	86,967	7%
Top 20 Total				216,239	105,865	53,341	57,106	110,447	4%

*Foundry

**Fabless

***Purchased by Micron on July 31, 2013

Source: IC Insights' Strategic Reviews Database

1H13 Top 20 Semiconductor Sales Leaders Ranked by Growth (\$M, Including Foundries)

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*Foundry

**Fabless

***Purchased by Micron on July 31, 2013

Source: IC Insights' Strategic Reviews Database

Forces Driving Consolidation

- Critical Mass
- Differentiation
- Collaboration

Shaping the Industry

Accelerating Innovation



Accelerating Technology Innovation

Differentiation

era of Electronics

Technology

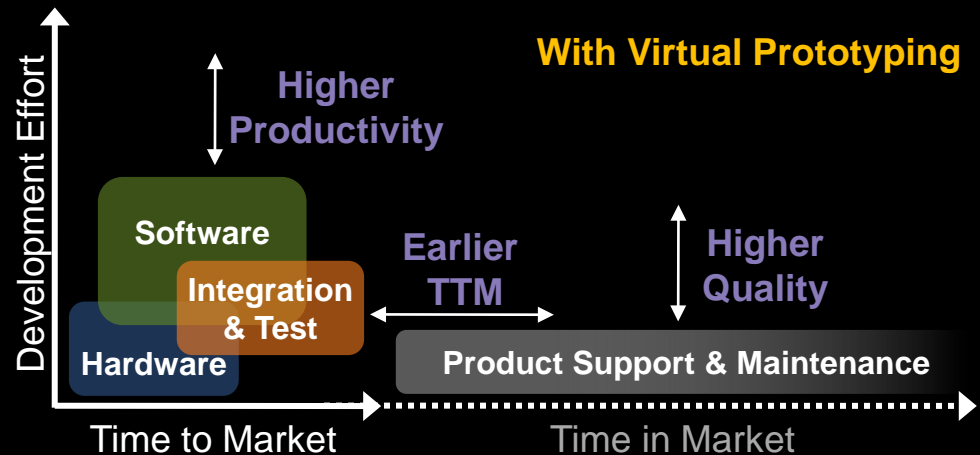
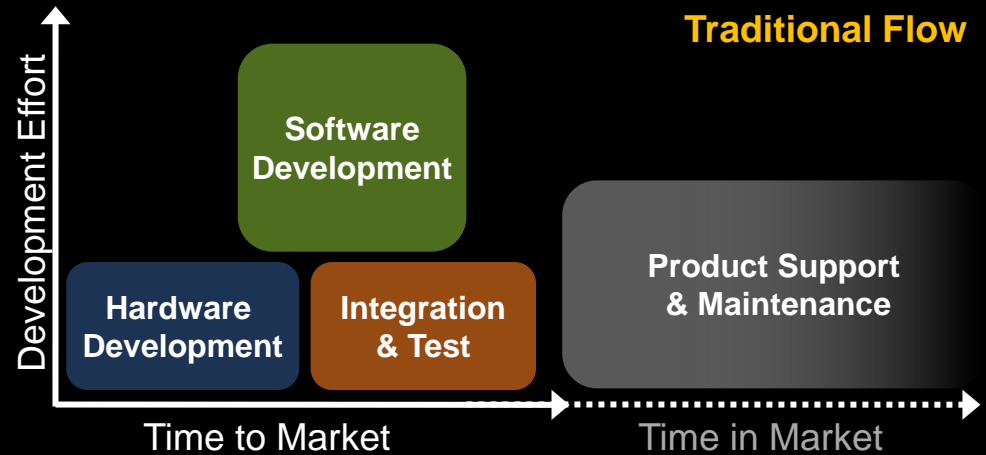
The Future Ahead

Prototyping Enables Earlier Software Development

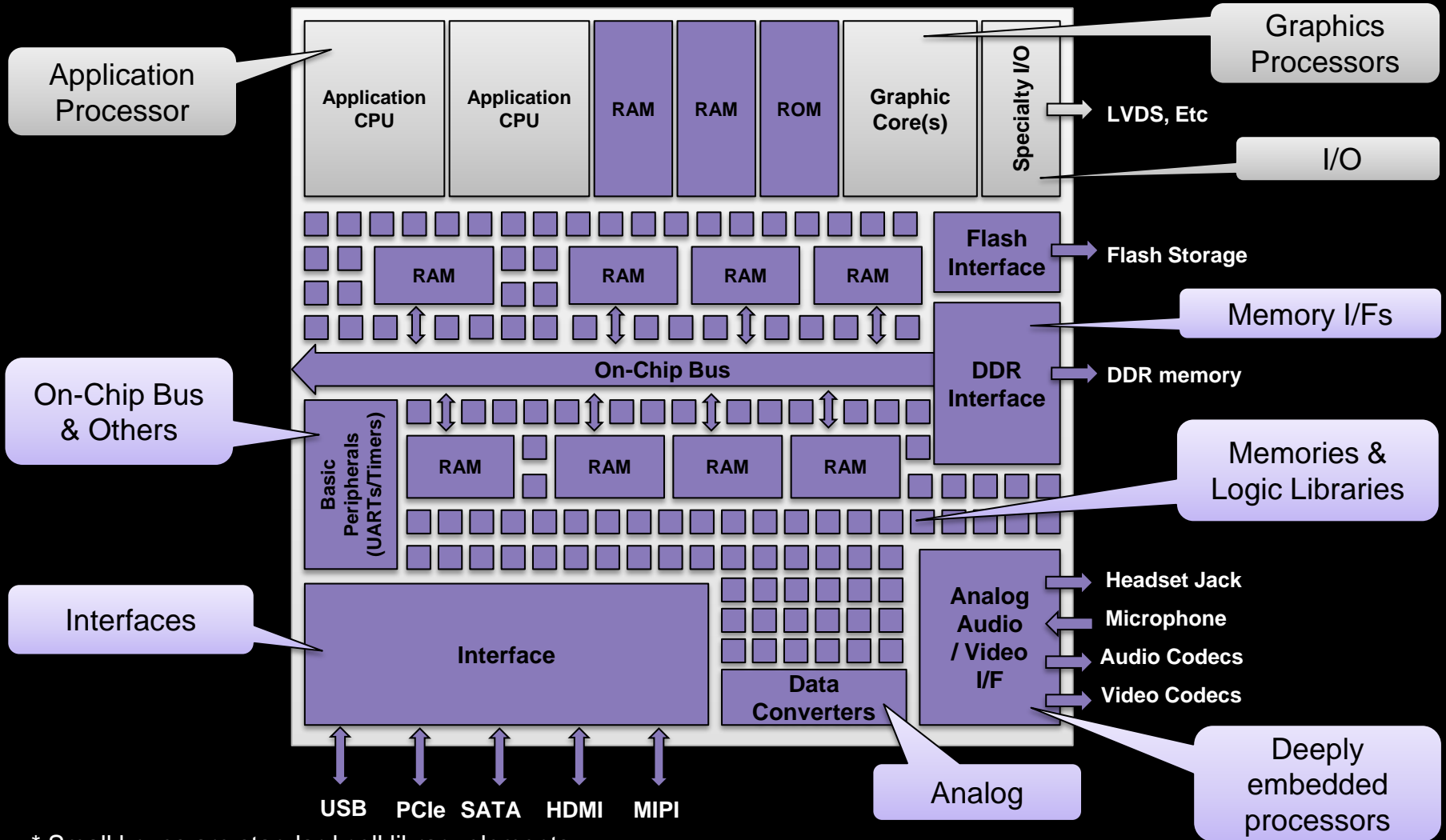


Prototype

A simulation model for the targeted hardware



Increasing Use of Silicon IP and Silicon IP Subsystems



* Small boxes are standard cell library elements.

Increasing Design Complexity

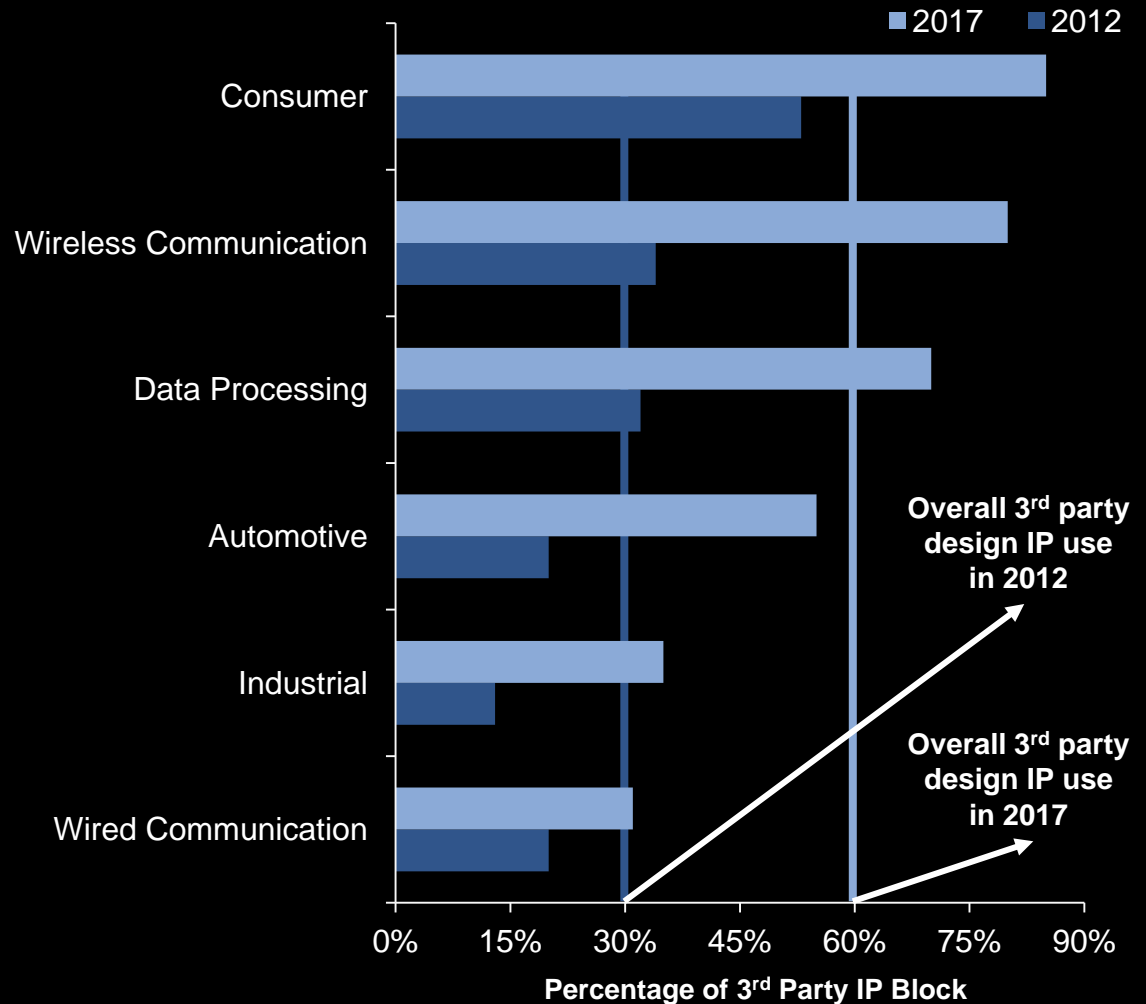
Escalating Design Costs

Shorter Time Window for New Product Launch



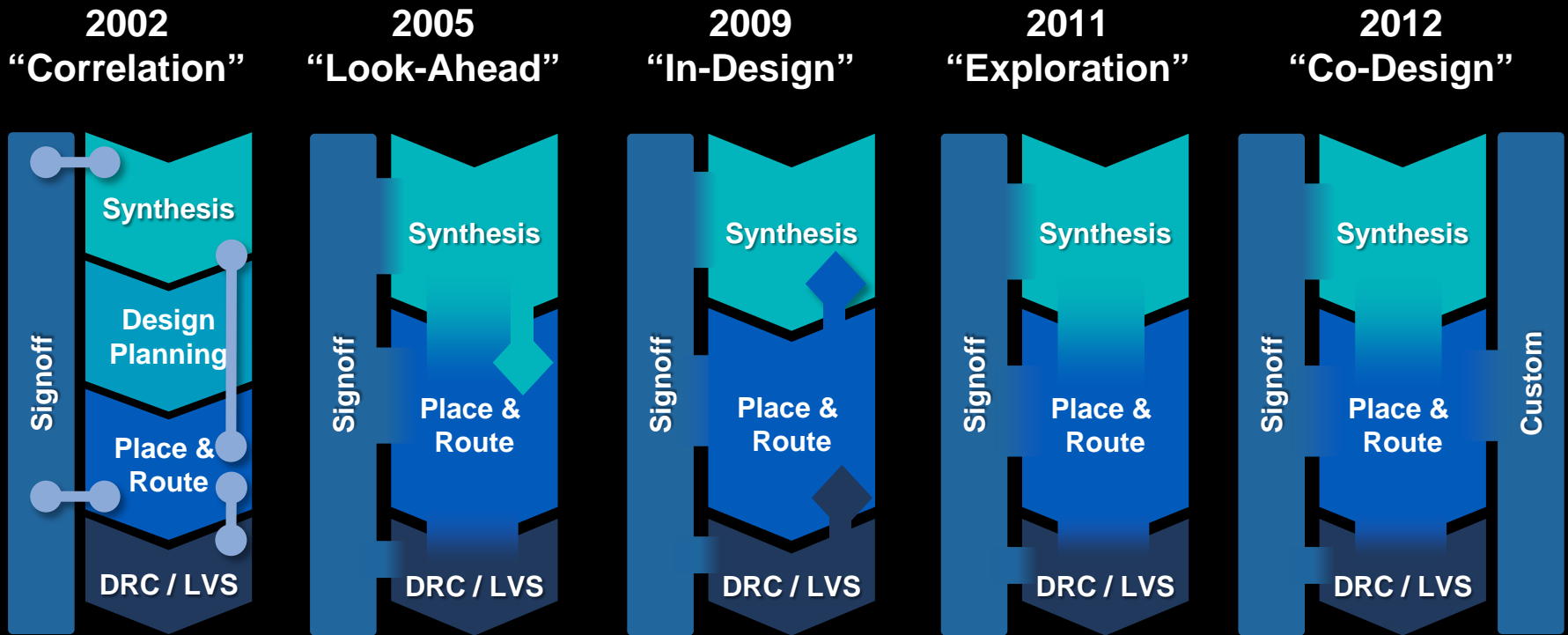
Strong Growth in 3rd Party IP Usage

3rd Party IP Usage Will Continue to Double Through 2017



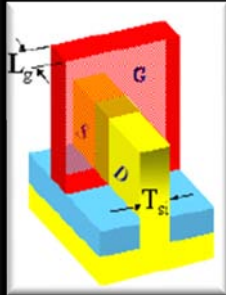
Source: Gartner, Semi IP Market, March 2013

Evolution of Implementation Technology

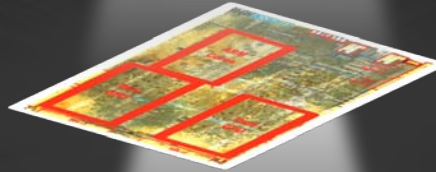


Below 22nm Requires Advanced Solutions

FinFET

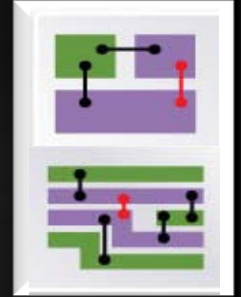


- Power
- Performance



Double Patterning (DPT)

- Density / Integration
- Performance
- Power



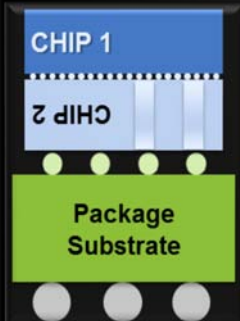
Power

Area



Performance

3D-IC



- Density / Integration
- Power
- Performance

**Delivering
More Performance
with Less Power
in a Smaller Area**

FinFET Technology Must Be Supported Across the Entire SoC Design Process

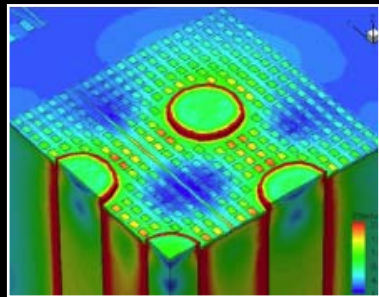
Process Develop.

Characterization

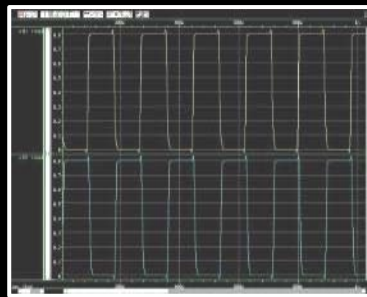
Design Implementation

IP

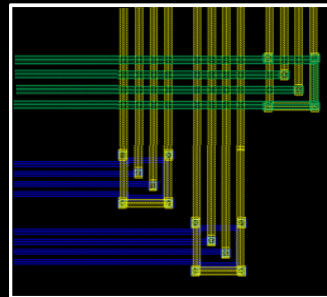
TCAD



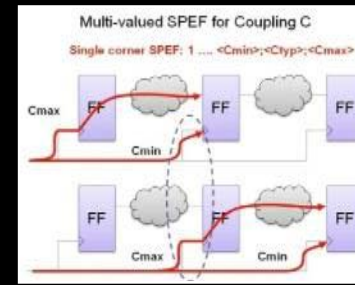
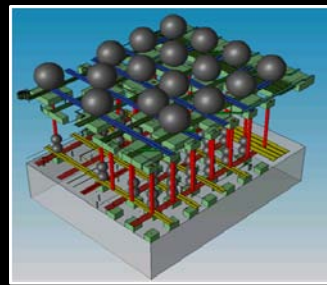
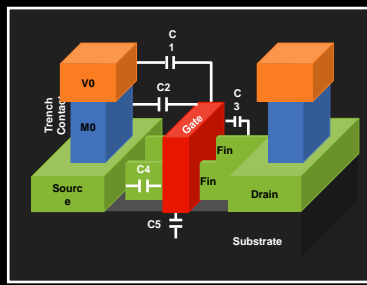
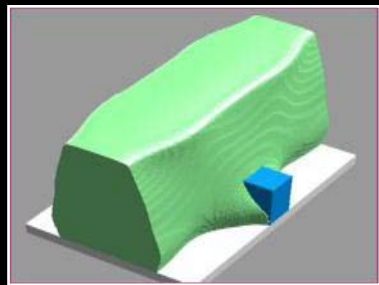
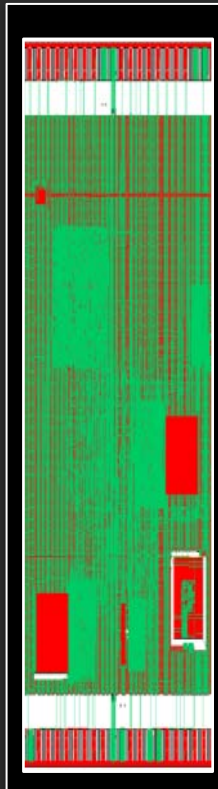
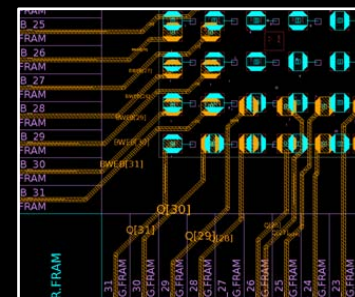
Circuit Simulation



Custom Design



Implementation



3D Lithography

Extraction

Physical Verification

Signoff

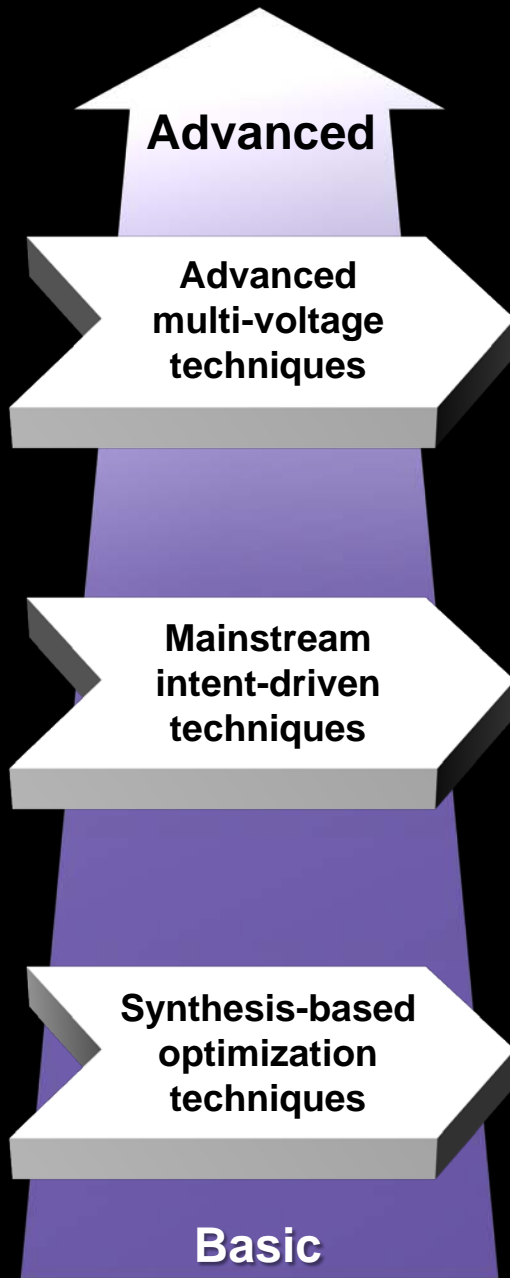
SoC Design

Requires

Advanced

Low Power

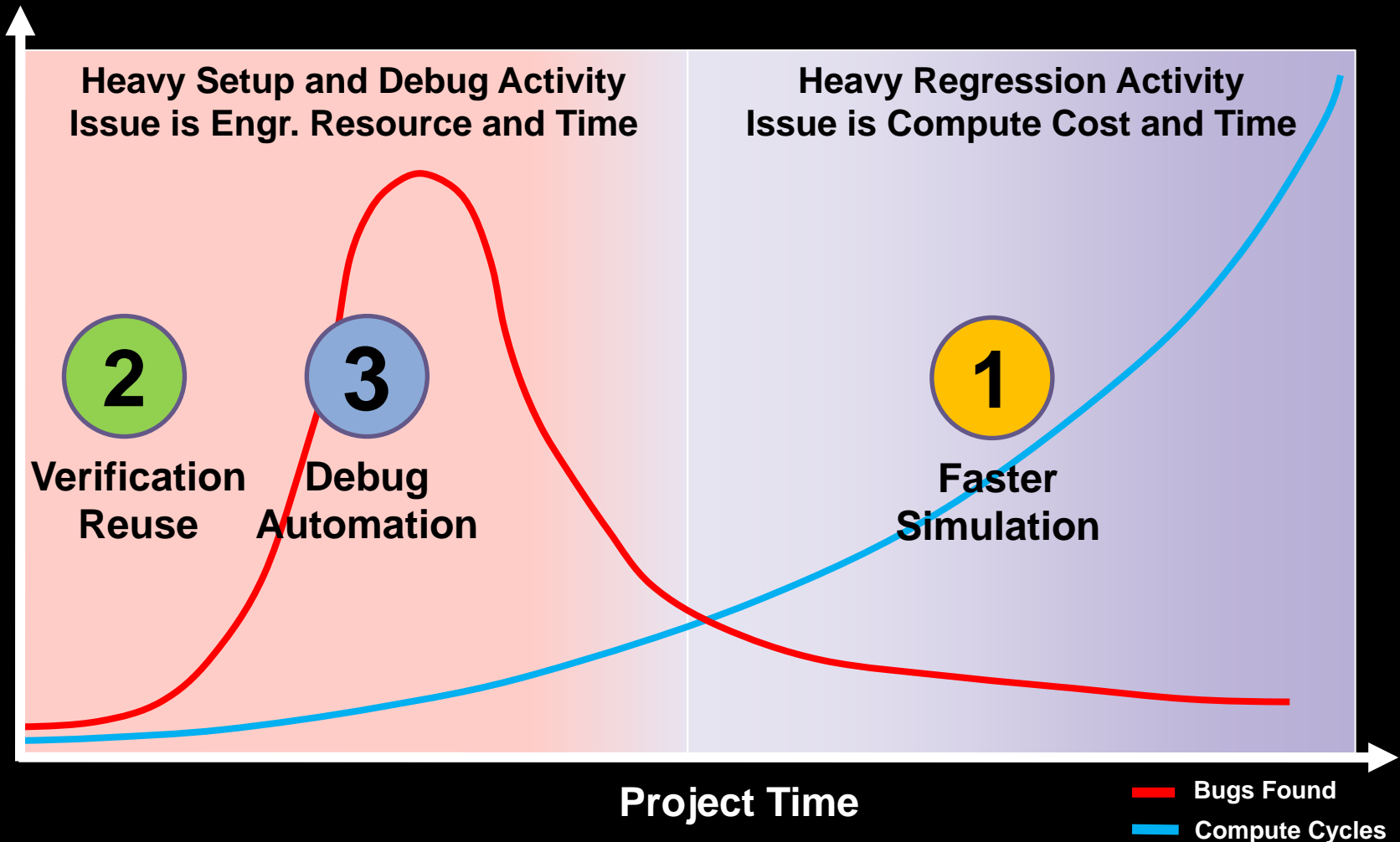
Techniques



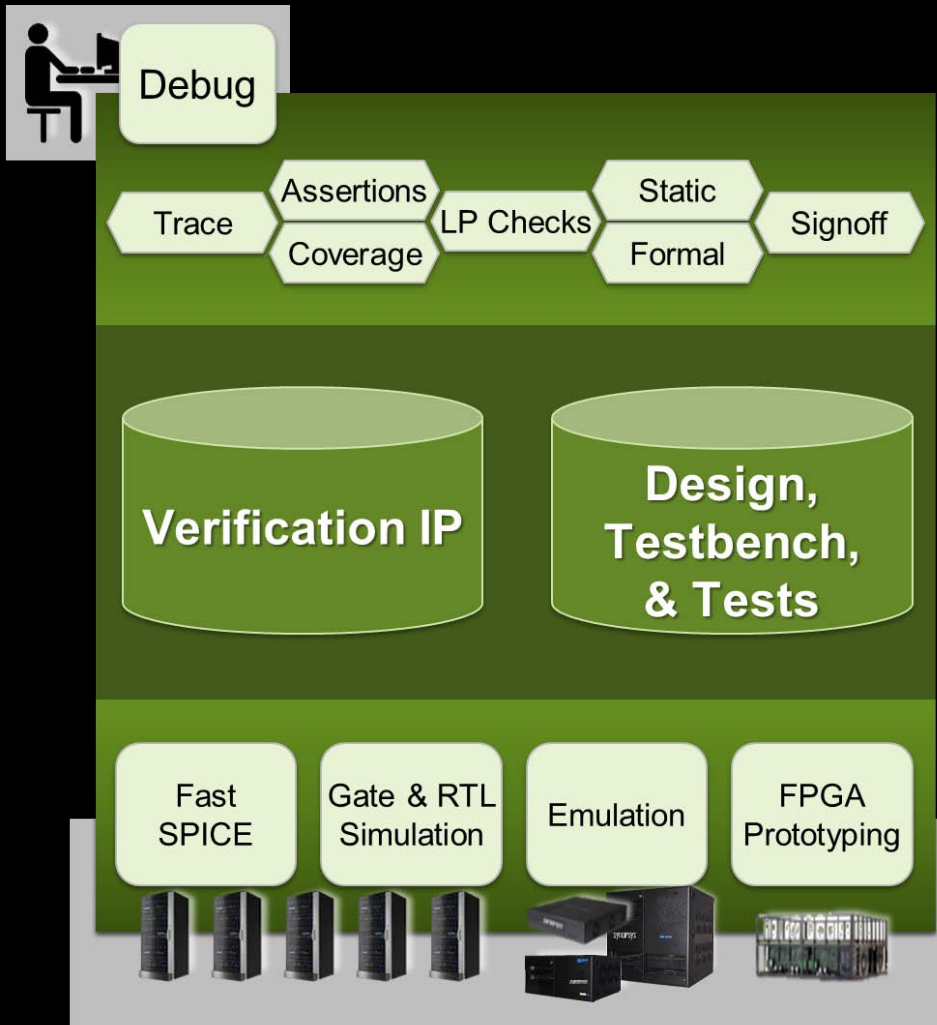
Low Power Design Techniques

Multi-Voltage 	Power Gating (Shutdown) 	DVFS, AVFS 																		
Well Biasing 	Clock Gating 	Low-VDD Standby 																		
Gate-Level Opt. 	Architect. Opt. <table border="1"><thead><tr><th></th><th>16 bit</th><th>64 bit</th></tr></thead><tbody><tr><td>Ripple</td><td>90</td><td>366</td></tr><tr><td>CLA</td><td>100</td><td>405</td></tr><tr><td>Carry Skip</td><td>108</td><td>437</td></tr><tr><td>Carry Select</td><td>161</td><td>711</td></tr><tr><td>Carry Save</td><td>218</td><td>1323</td></tr></tbody></table>		16 bit	64 bit	Ripple	90	366	CLA	100	405	Carry Skip	108	437	Carry Select	161	711	Carry Save	218	1323	Multi-Threshold
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CLA	100	405																		
Carry Skip	108	437																		
Carry Select	161	711																		
Carry Save	218	1323																		

The Problem in Verification Is Time & Cost



Comprehensive SoC Verification Platform Manages Time-to-market & Verification Complexity



Technology Must Address

- Performance
- Capacity
- Accuracy
- Productivity
- Standards
- Digital
- Low-Power
- AMS
- HW/SW

Accelerating Technology Innovation

Collaboration

1. Industry
2. University
3. Government

Technology

The Future Ahead





**Environmental
Legal Ethical
Technology
Economics**

Different Disciplines

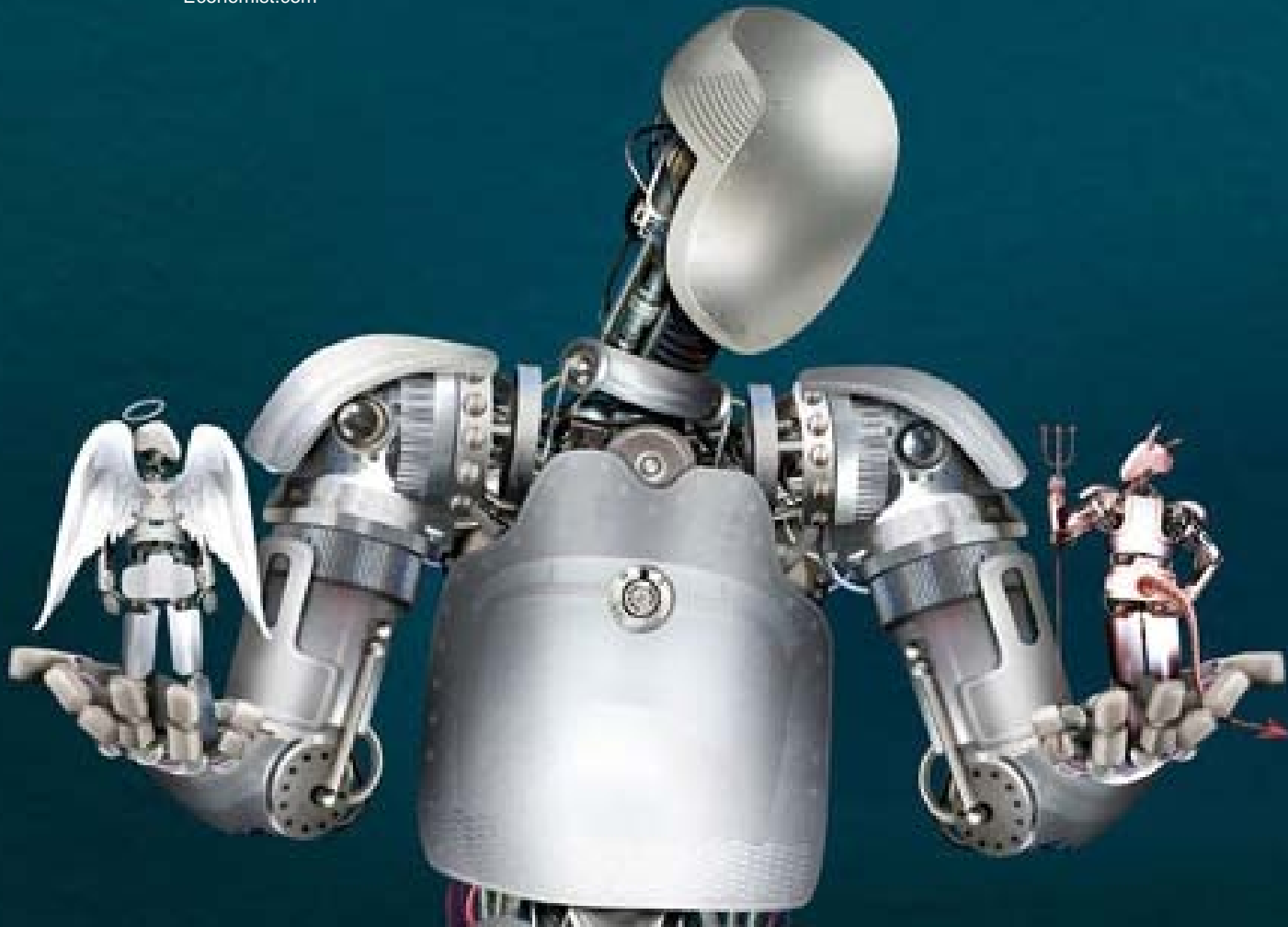
The Economist

Morals and the Machine

Teaching robots right from wrong

June 2, 2012

Economist.com



A Car or a Computer on Four Wheels?

Under the bonnet

How a self-driving car works

Signals from **GPS (global positioning system)** satellites are combined with readings from tachometers, altimeters and gyroscopes to provide more accurate positioning than is possible with GPS alone

Lidar (light detection and ranging) sensors bounce pulses of light off the surroundings. These are analysed to identify lane markings and the edges of roads

Video cameras detect traffic lights, read road signs, keep track of the position of other vehicles and look out for pedestrians and obstacles on the road

Radar sensor

Ultrasonic sensors may be used to measure the position of objects very close to the vehicle, such as curbs and other vehicles when parking

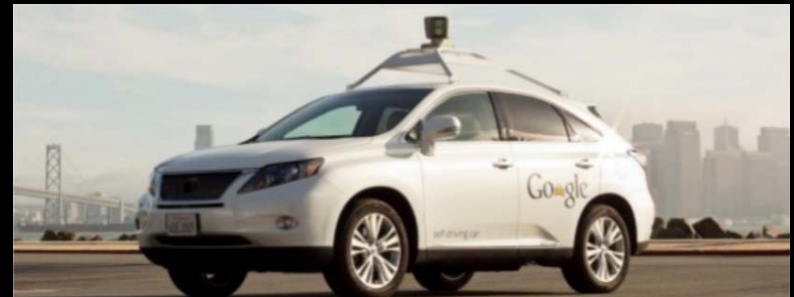
The information from all of the sensors is analysed by a **central computer** that manipulates the steering, accelerator and brakes. Its software must understand the rules of the road, both formal and informal

Radar sensors monitor the position of other vehicles nearby. Such sensors are already used in adaptive cruise-control systems

Source: *The Economist*

California becomes latest state to OK driverless cars

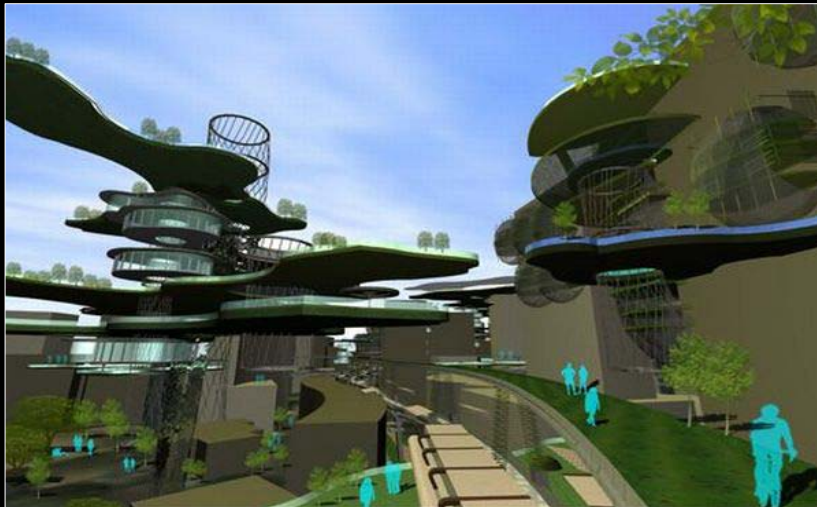
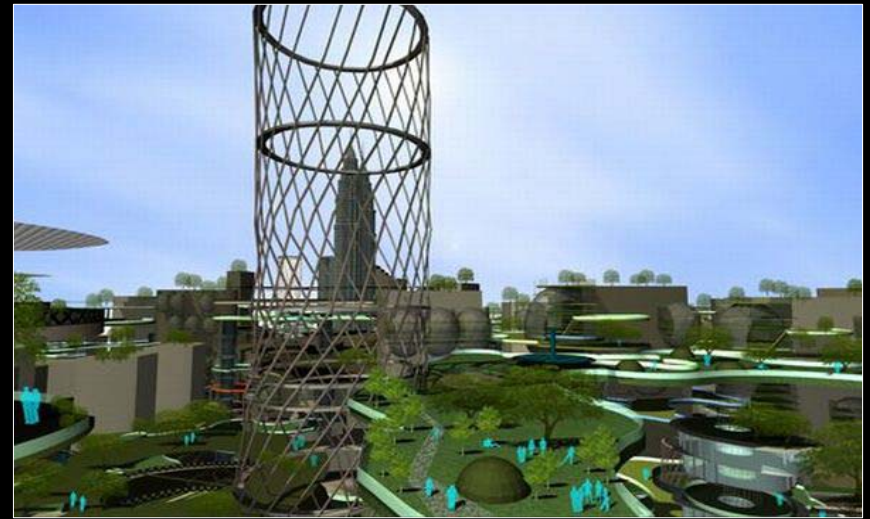
September 25, 2012



Sources: USA TODAY, California becomes latest state to OK driverless cars, September 25, 2012.
The Economist, Look, no hands, September 1, 2012.

The New Green Hub

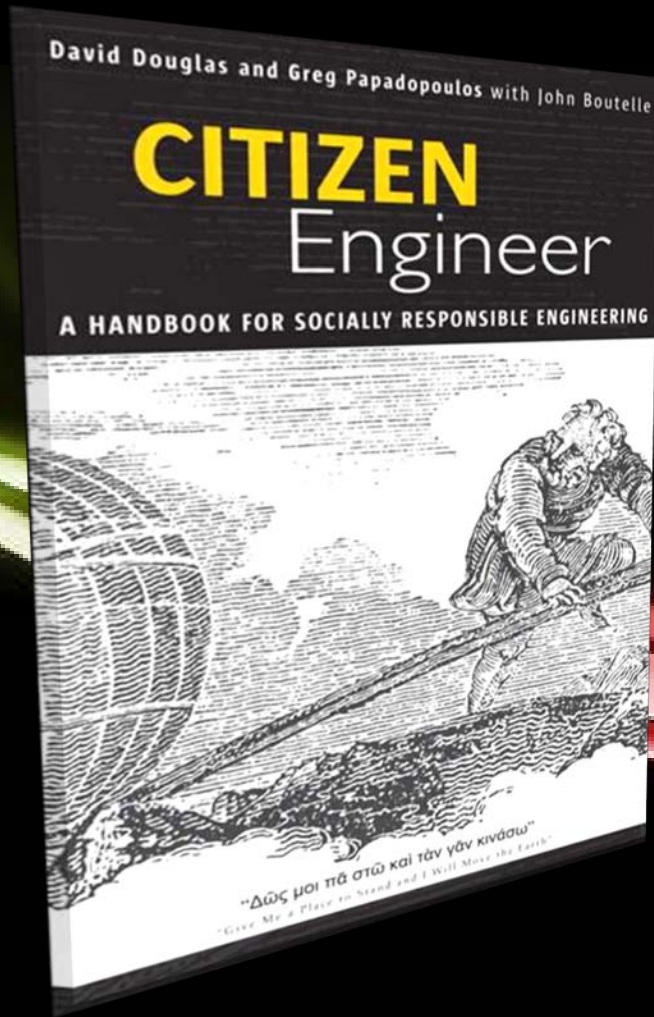
Shifting Gears to Sustainable Development



Source: Ecofriend.com – Urban Reforestation: Sky-bridges & green connectors to give a new skyline to Kuala Lumpur

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