

The Future of Semiconductor Industry from “Fabless” Perspective

Roawen Chen, Ph.D.

*GM and VP of Connectivity Business Unit
& VP of Manufacturing Operations*

Marvell Semiconductor

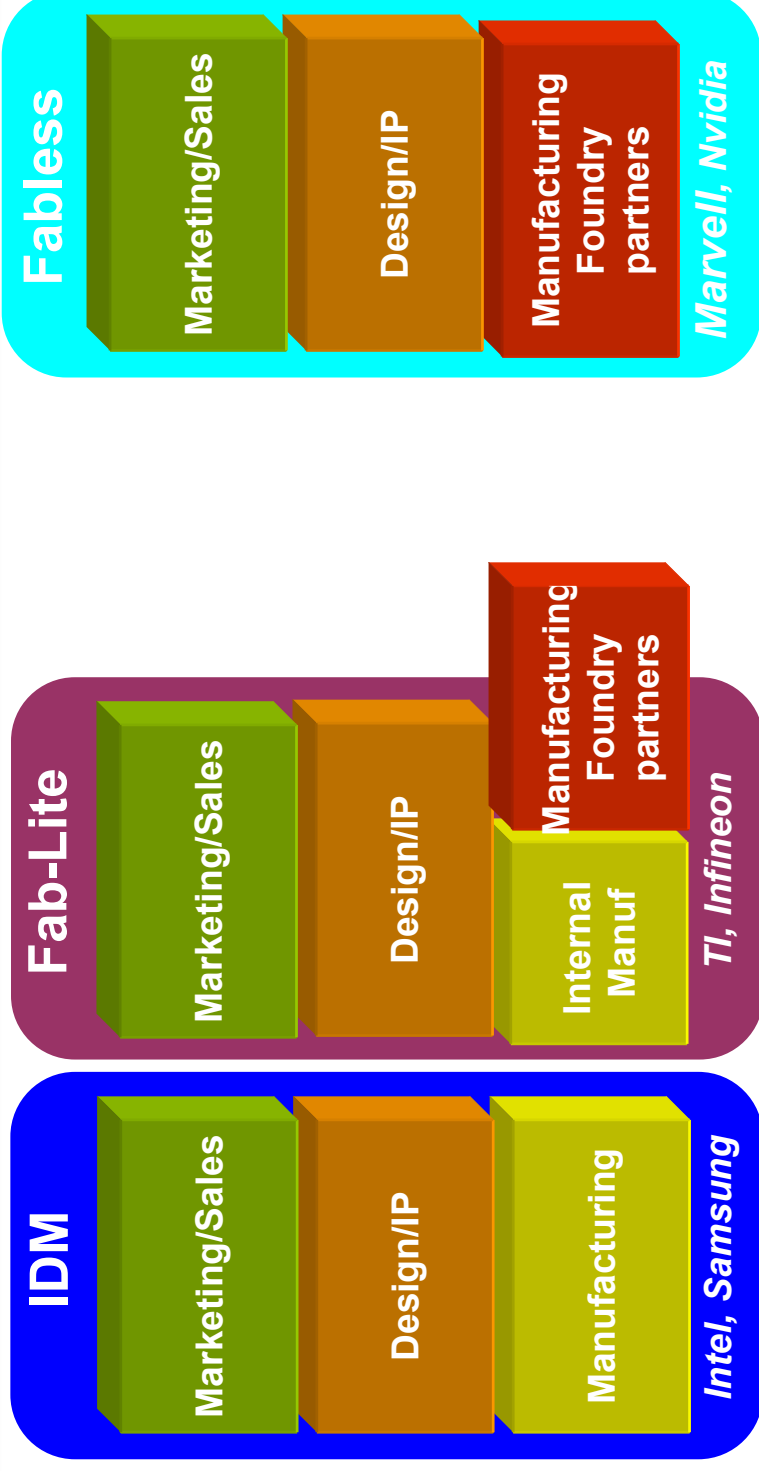
UC Berkeley Solid-State Seminar

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Outline

- ▶ Introduction
- ▶ Fabless Business Model Adoption
- ▶ Foundry Technology and Industry Trend
- ▶ Observation of the Future of Semiconductor industry

Semiconductor Business Models



Semiconductor manufacturing models are migrating to asset-light strategy

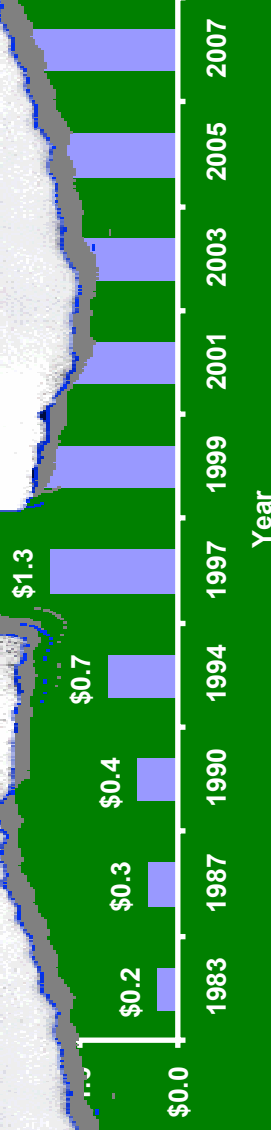
Soaring Cost of Chip Making

"THIS IS ALL VERY SEXY STUFF, BUT IT IS GOING TO BE EXPENSIVE, AND SOMEONE IS GOING TO HAVE TO PAY FOR IT."

-- Rick Cassidy, President, TSMC North America

"OUTSIDE OF INTEL, I DON'T KNOW WHO COULD DO IT ALONE THERE HAS TO BE A COALITION."

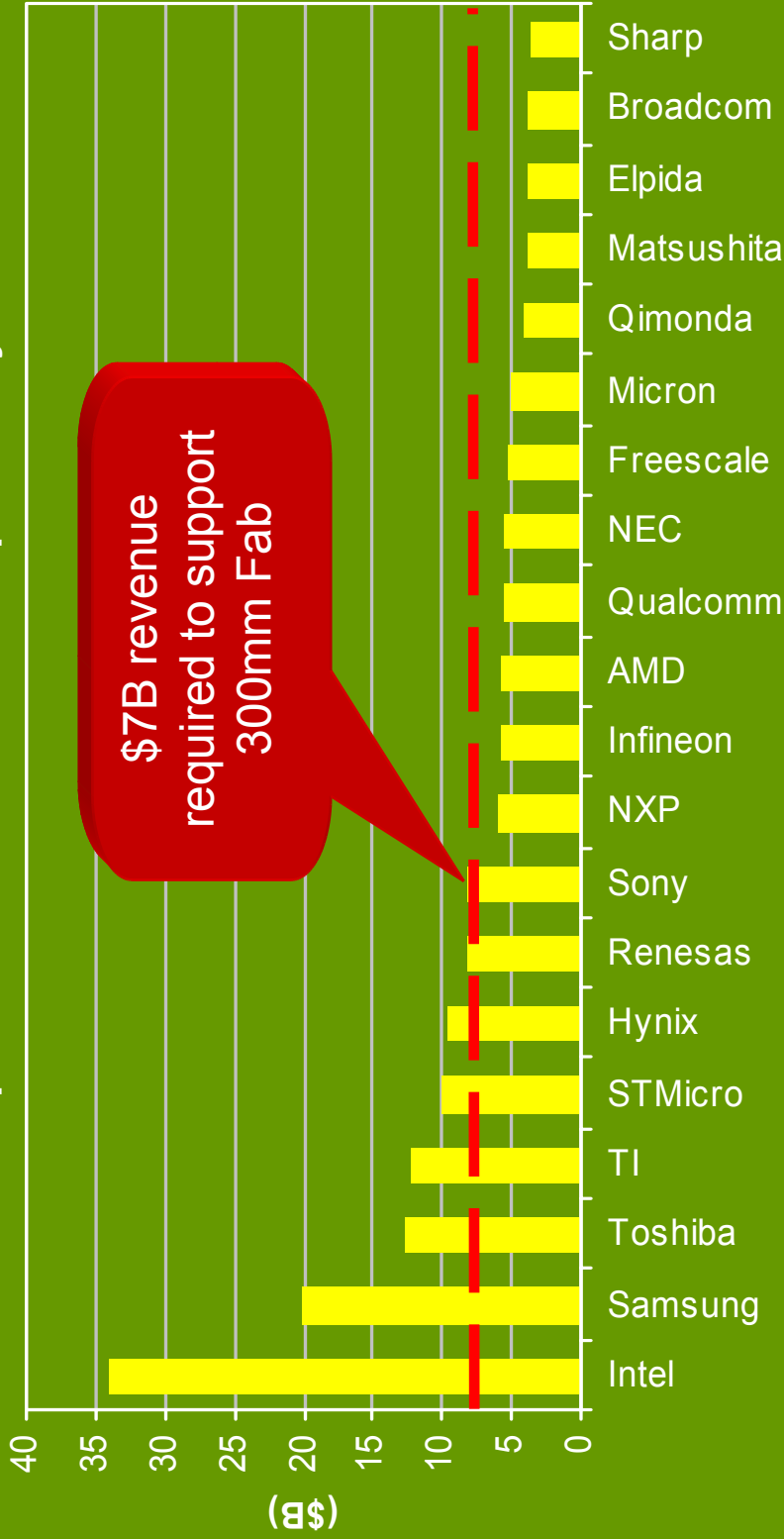
-- Hector Ruiz, CEO, AMD



The cost of being IDM is increasing with each new tech node advancement, resulting in a outsourcing phenomenon

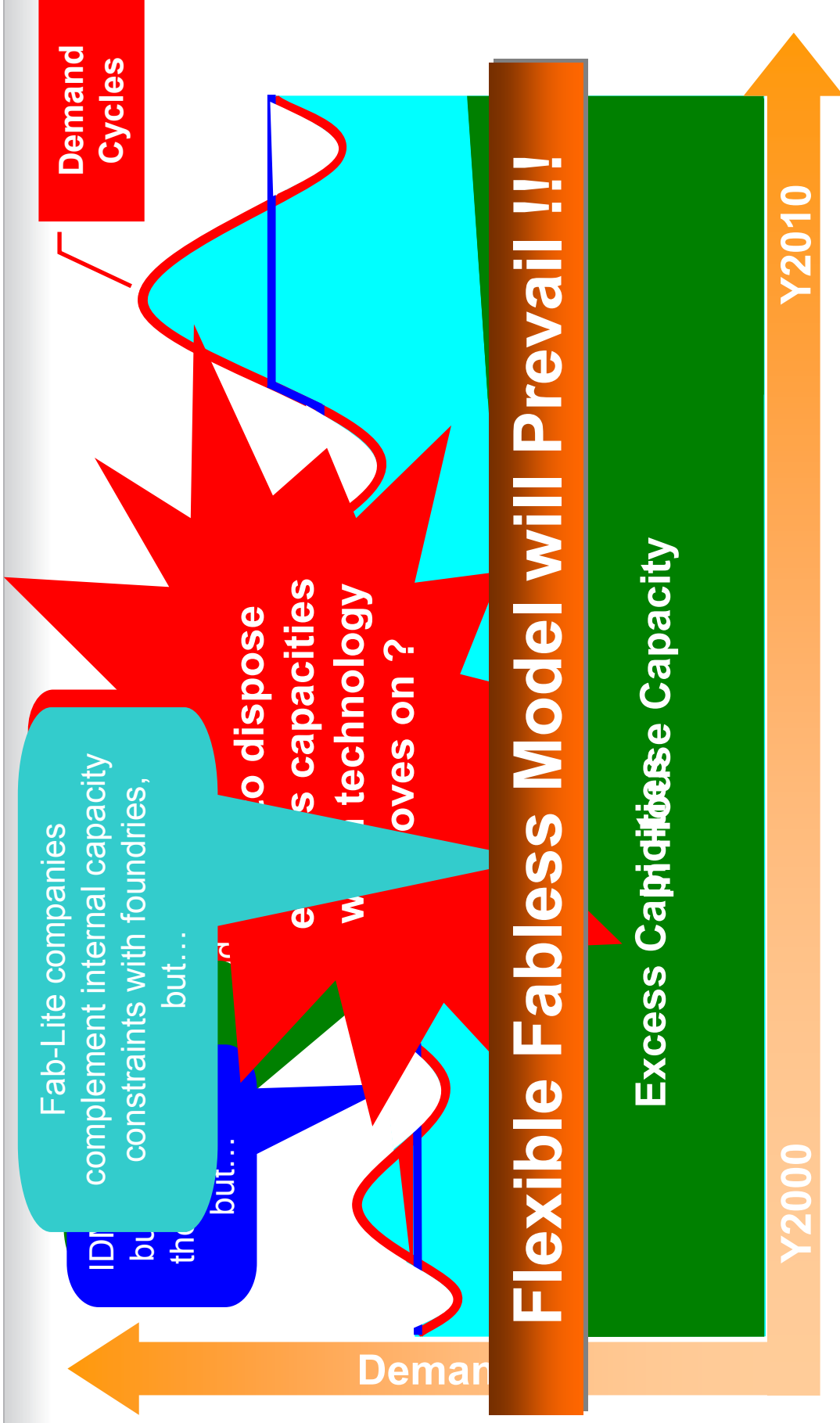
Fab is simply unaffordable by IDM model

2007 Top 20 Semiconductor Companies by Revenue

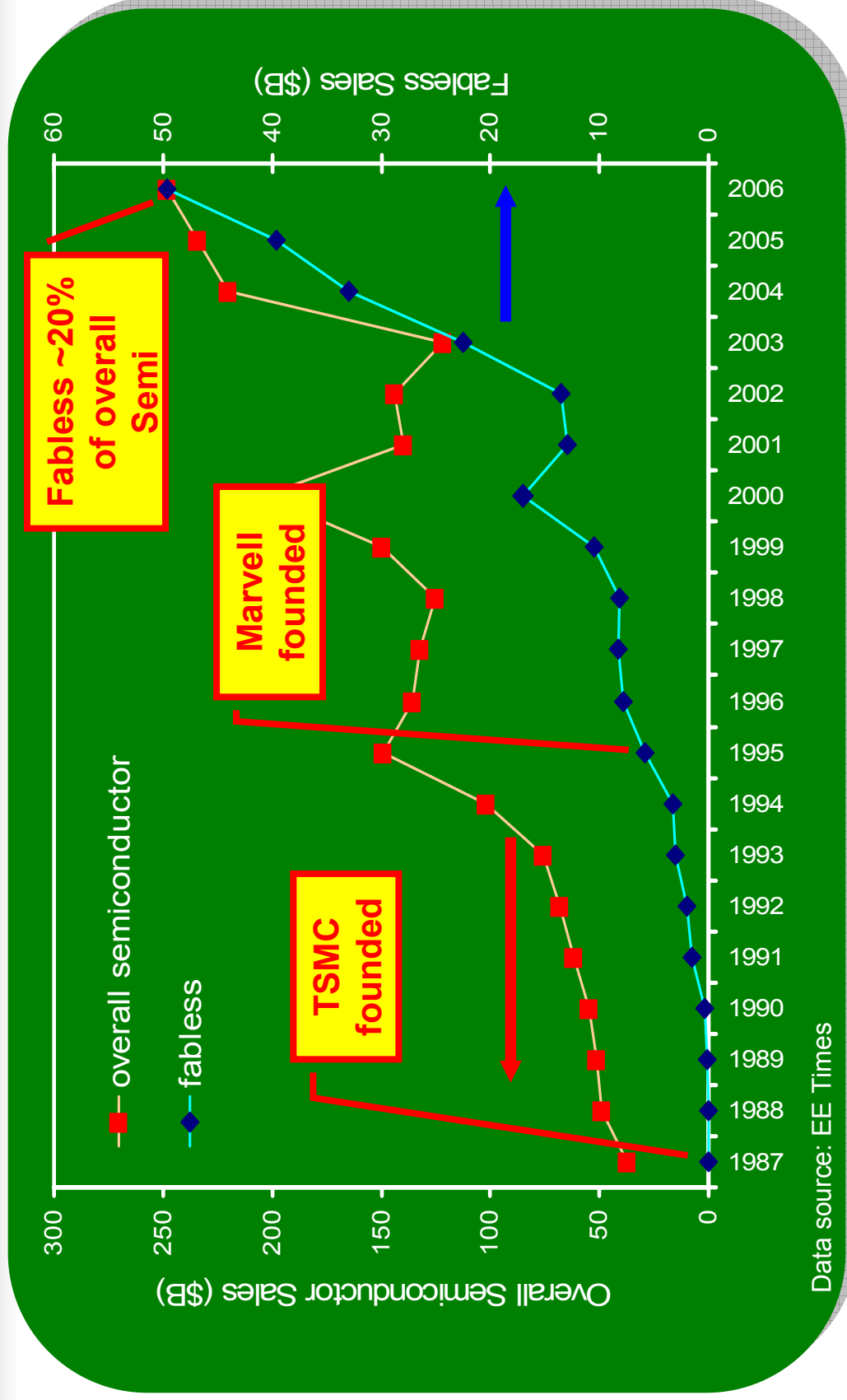


Data source: Goldman Sachs

Why Fabless Business Model Attractive?



Fabless Semiconductor Growth



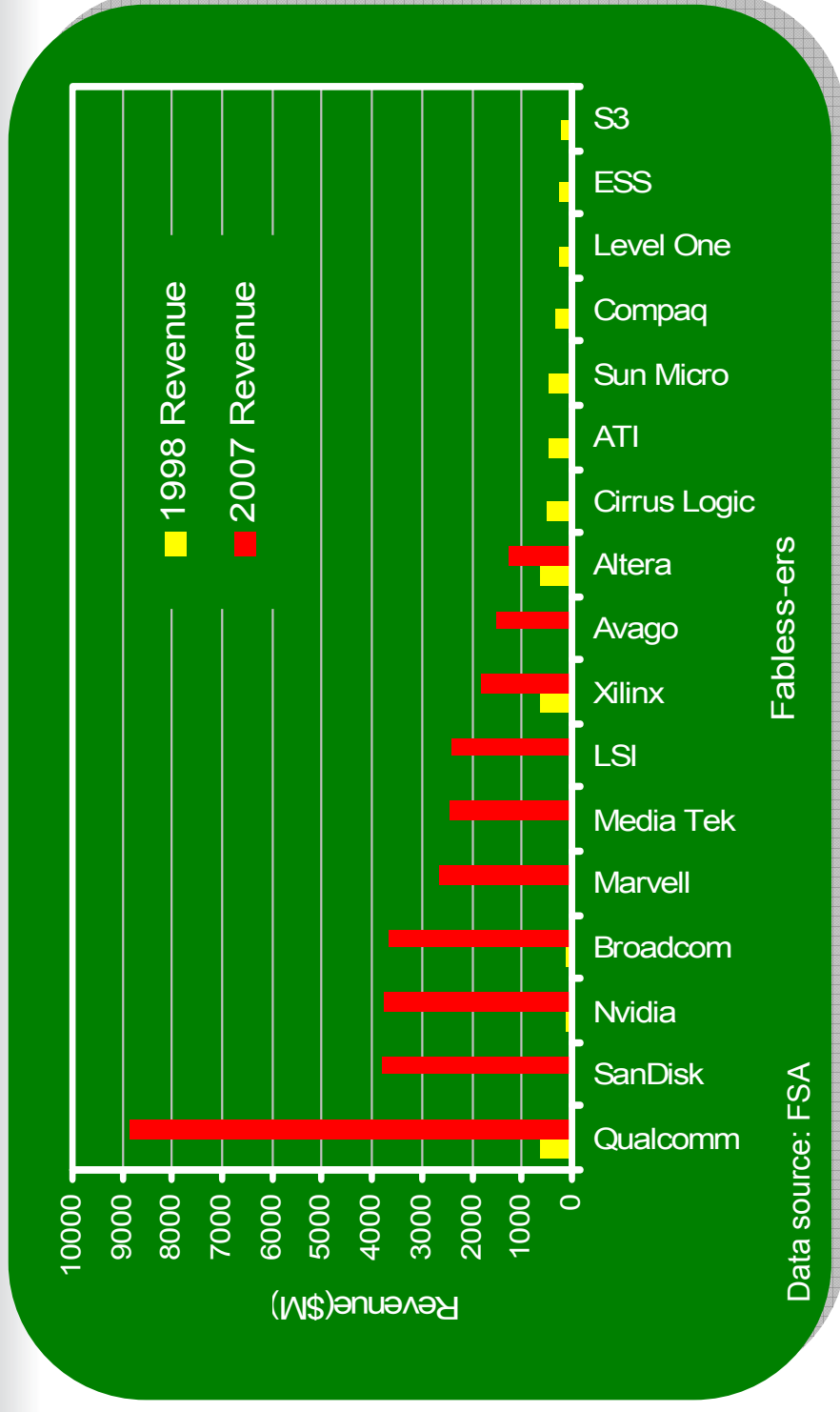
Real Men Started to Rent Fabs

Q1 '07 Rank	Q2 '07 Rank	Company Name	Q1-07 Revenue(\$M)	Q2-07 Revenue(\$M)	% of Total	
1	1	Intel	7,868	7,728	12.25%	Intel
2	2	Samsung Electronics	4,835	4,716	7.48%	Memory
4	3	Texas Instruments	2,900	3,030	4.80%	Fab-lite
3	4	Toshiba	3,109	2,510	3.98%	Fab-lite
6	5	STMicroelectronics	2,276	2,418	3.83%	Fab-lite
8	6	Renesas Technology	1,948	1,985	3.15%	Fab-lite
5	7	Hynix	2,539	1,963	3.11%	Fab-lite
9	8	NXP	1,427	1,472	2.33%	Fab-lite
14	9	Qualcomm	1,259	1,367	2.17%	Fab-less
13	10	Infineon Technologies	1,282	1,363	2.16%	Fab-less
		All Others	35,975	34,519	54.73%	
		Total Semiconductor	65,418	63,071	100%	

Data source: FSA

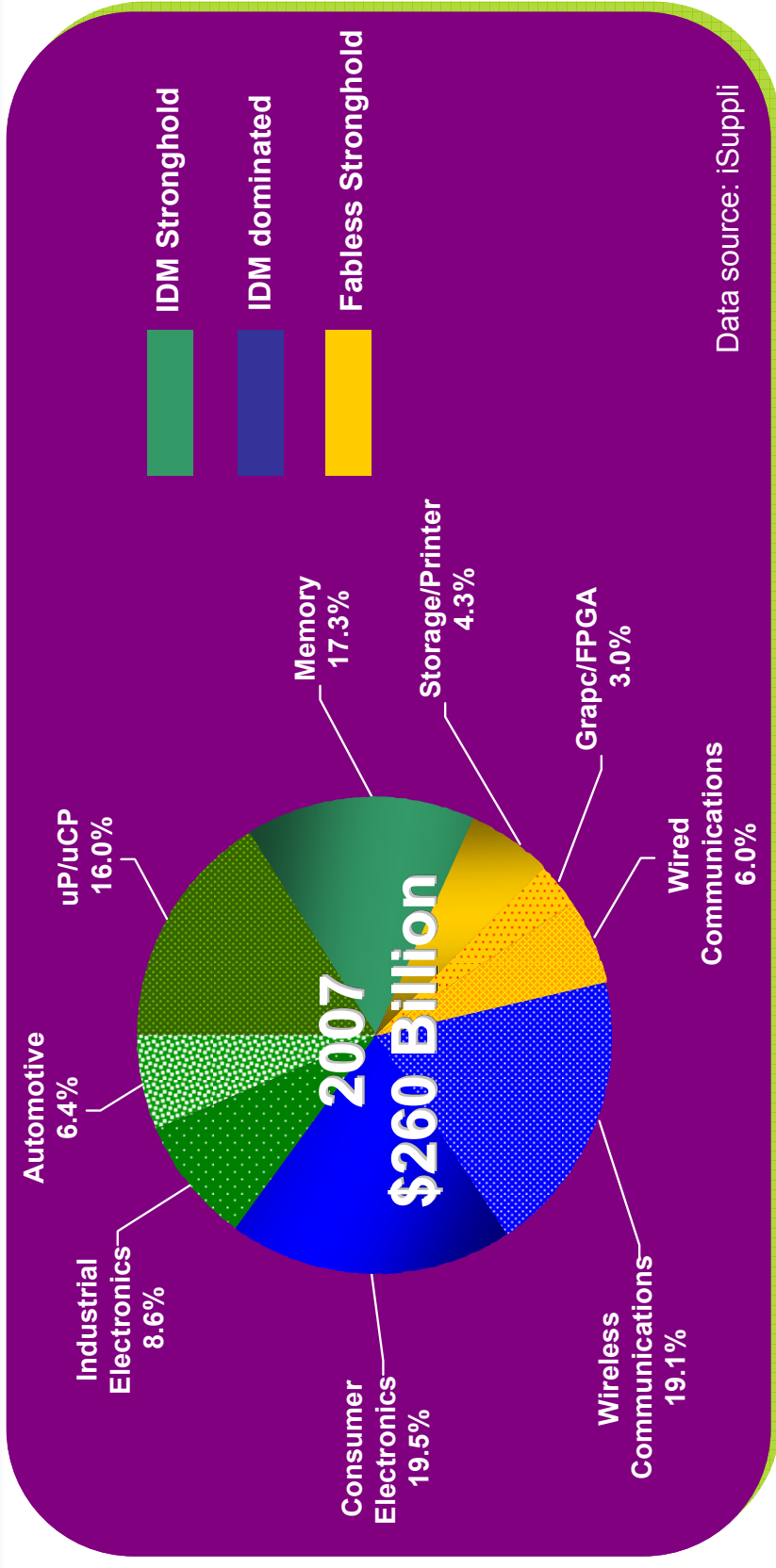
Fabless company, for the first time, enters Semiconductor Top-10 (Q2 2007)

Fabless Companies: No longer small players



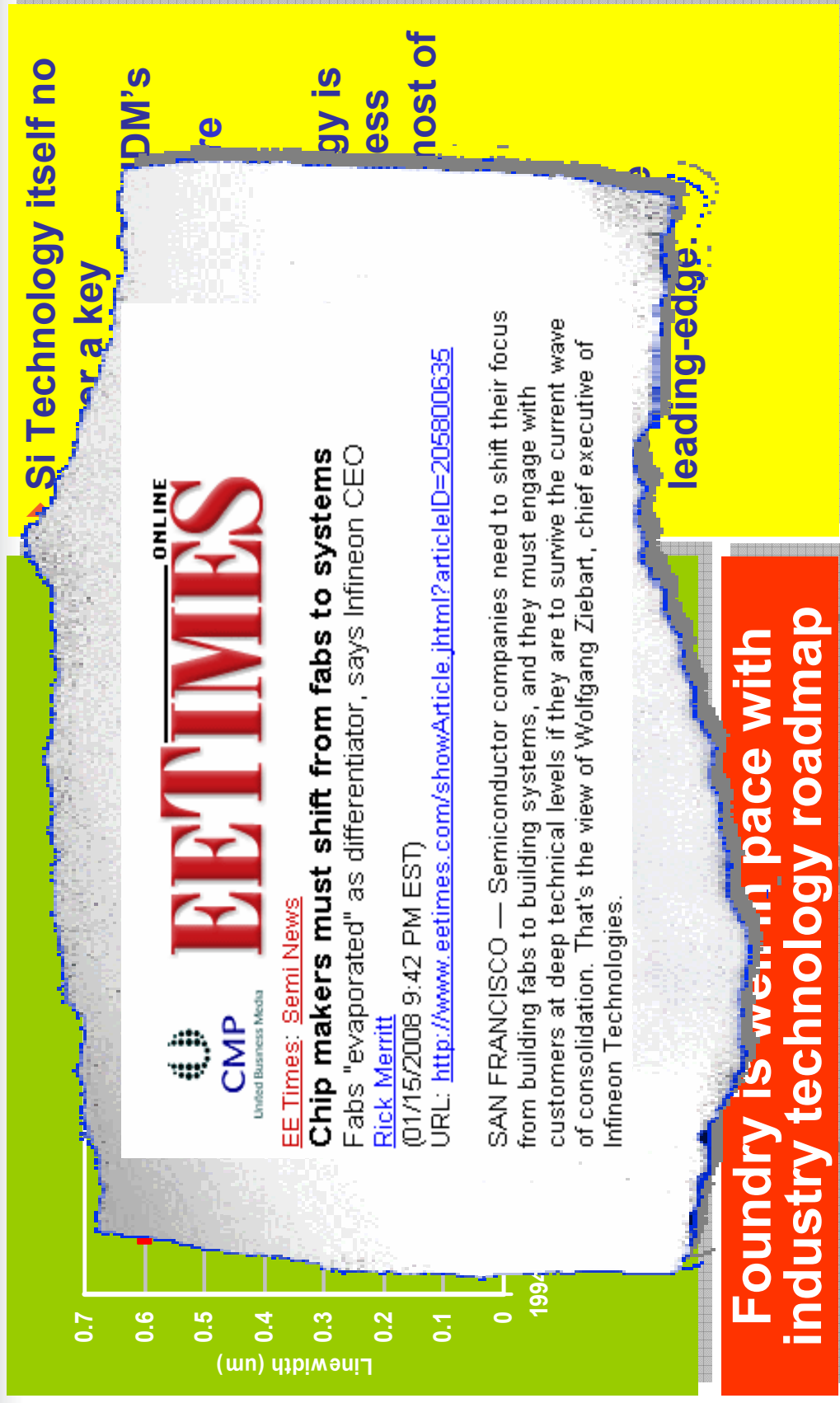
In 1998, top 3 fabless companies (Altera, Qualcomm and Xilinx) each had ~\$500M annual revenue; Today in 2008, more than 10 fabless companies have each surpassed \$1B in annual revenue

Fabless revenue is merely ~20% of Worldwide IC\$, Potential Growth is Huge



Fabless company grows from traditional trench, it is inevitable to invade into IDM pie. Wireless and Consumer electronics are two likely areas

Process Technology is no longer Differentiator



Foundry Technology in Par with Industry Leader



Session 10: Integrated Circuits and Manufacturing - Advanced CMOS Logic and SoC Platforms

Click on above link for Session Outline

Co-Chairs: Jon Cheek, Freescale Semiconductor
John Pellerin, Advanced Micro Devices

10.1 A Highly Scaled, High Performance 45nm Bulk Logic CMOS Technology with 0.242 μm^2 SRAM Cell

10.2 A 45nm Logic Technology with High-k+Metal Gate Transistors, Strained Silicon, 9 Cu Interconnect Layers, 193nm Dry Patterning, and 100% Pb-Free Packaging

► TSMC and Intel featured 2007 IEDM with 2 most significant papers

► TSMC

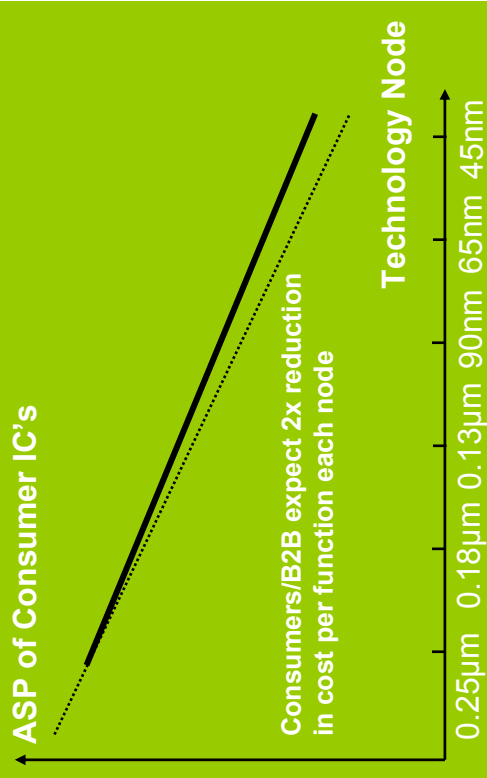
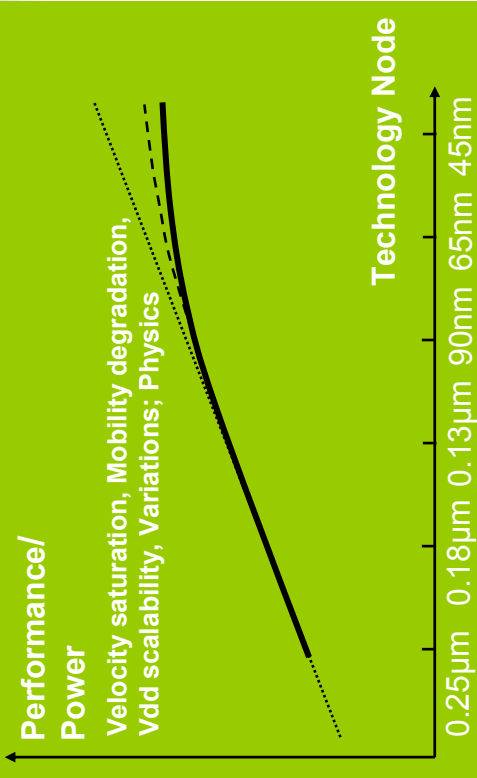
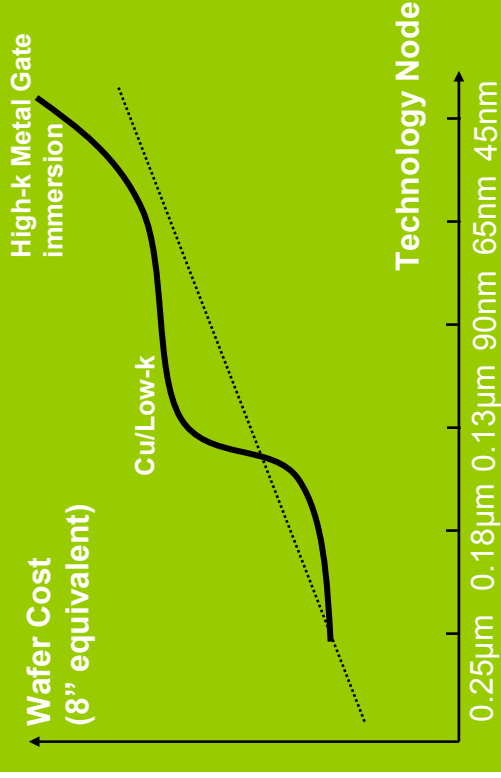
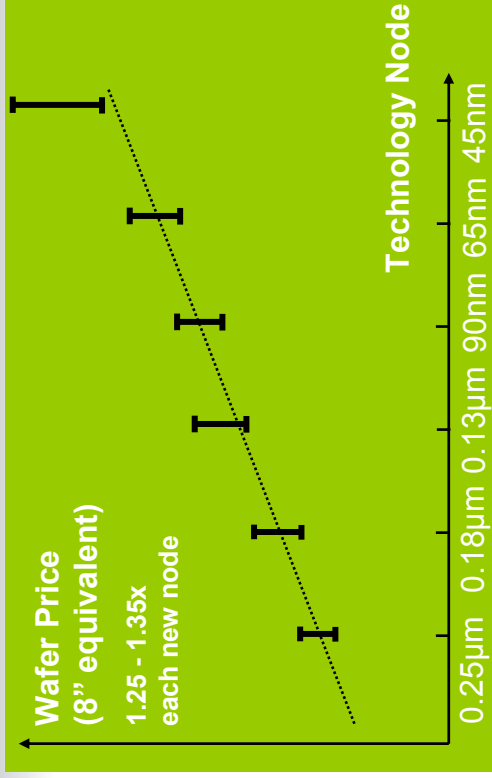
- Traditional SiO₂ Gate Oxide w/ Nitridation
- Immersion Litho (193nm w/ 1.35 Max NA)
- Ultra Low-K (K=2.55)

► Intel

- High-K Metal Gate (dual WF gate metal)
- Dry Litho (193nm w/ 0.92 NA)

► Foundry process choice is more cost-effective and diversified

32nm and beyond?



With all these boundary conditions, ROI beyond 32nm may be questionable

Future Trends of Semiconductor Industry

- ▶ Three types of Semiconductor players in the future
 - Intel
 - Memory
 - Fabless/Foundry
- ▶ TSMC dominance, standardization of CMOS process offers
- ▶ “Device scaling” diminishing and “dimension scaling” slow if not stop
- ▶ Consolidation is inevitable, big becomes bigger, economic scales win
- ▶ Innovation and collaboration are our hopes for future success of IC – innovations never die. Some potential topics are
 - Non-CMOS technologies at mature process node. E.g., Ultra-HV power device (energy efficient), MEMS.....etc.
 - How to reduce high mask cost (critical for innovative designs to fly)
 - Breakthrough in nano-devices compatible with current CMOS Si infrastructure
- Top research in mechanical/thermal aspects of packaging
- Design for Manufacturing (DFM) a must for 45nm and beyond

Summary

- ▶ Fab costs sharply increase during the last decade, technology brings only incremental benefit which may not justify the high financial risk of owning fab. Process Technology becomes standardized.
- ▶ Analysis of the fabless/foundry business model illustrates that it is the preferred model for companies to excel in the semiconductor industry, with the highest flexibility to address dynamic markets
- ▶ IDM's are transitioning into fablite or fabless somewhere in between 65nm and 32nm
- ▶ As fabless becomes mainstream, paradigm shift demands innovation and collaboration among supply-chains, to further lower the cost of IC's and accelerate the growth of semiconductor industry

Paradigm Shift

“Only Real Men have Fabs”

Jerry Sanders III, CEO of AMD, circa. 1991

“Only Real Men Go Fabless”



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