The Future of Semiconductor Industry from “Fabless” Perspective

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Outline

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

$7B revenue required to support 300mm Fab

Data source: Goldman Sachs
Why Fabless Business Model Attractive?

Fab-Lite companies complement internal capacity constraints with foundries, but...

IDM capacity built follows the demand, but...

To dispose excess capacities when technology moves on?

Flexible Fabless Model will Prevail!!!
Fabless Semiconductor Growth

Overall Semiconductor Sales ($B)

Data source: EE Times

Fabless ~20% of overall Semi

TSMC founded

Marvell founded
### Real Men Started to Rent Fabs

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

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

Data source: FSA
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 $1B in annual revenue.
Fableless revenue is merely ~20% of Worldwide IC$, 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 a differentiator for IDM’s. Technology is more standardized. Foundry technology is the de-facto process choice today for most of semiconductor companies. Foundry process technology is the leading-edge.

EE Times: Semi News
Chip makers must shift from fabs to systems
Fabs "evaporated" as differentiator, says Infineon CEO
Rick Merritt
(01/15/2008 9:42 PM EST)
URL: http://www.eetimes.com/showArticle.jhtml?articleID=205800635

SAN FRANCISCO — Semiconductor companies need to shift their focus from building fabs to building systems, and they must engage with customers at deep technical levels if they are to survive the current wave of consolidation. That’s the view of Wolfgang Ziebart, chief executive of Infineon Technologies.
Foundry Technology in Par with Industry Leader

- 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.
“Only Real Men have Fabs”
Jerry Sanders III, CEO of AMD, circa. 1991

“Only Real Men Go Fabless”