

Acceleration Management: The Semiconductor Industry Confronts the 21st Century

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Overview

1. Acceleration Management

a. Definition

b. Application to the Semiconductor Industry

1) change in "speed" and "direction"

c. 7 Looming Technical Challenges

d. Managerial Implications

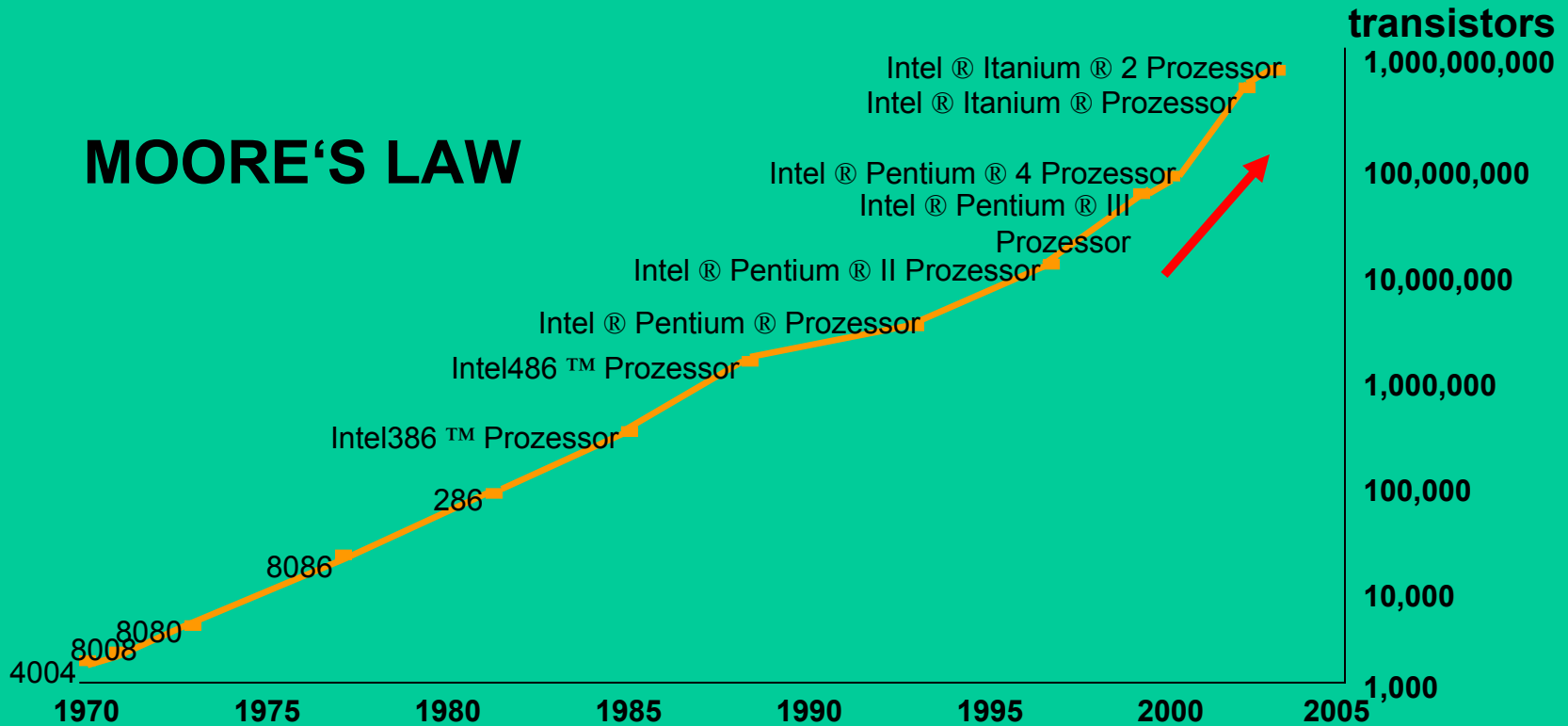
2. Entry Points for China-based Operations

1a. Acceleration Management: *Definition*

1. The next phase beyond “High Velocity” competitive environments
 - a. *represents not only an increase in the rate of technological change*
 - b. *but also a change in direction through novel architectures and “in-sourcing” key capabilities*
 - 1) *Semiconductor companies try to “beat” the industry roadmap but also have to coordinate closely with supply chain*
2. This acceleration gives rise to:
 - a. *rethinking approaches to new process/product development in the semiconductor industry*
 - b. *new managerial imperatives (discussed below)*

1b. Acceleration Management: Application to the Semiconductor Industry— change in "speed"

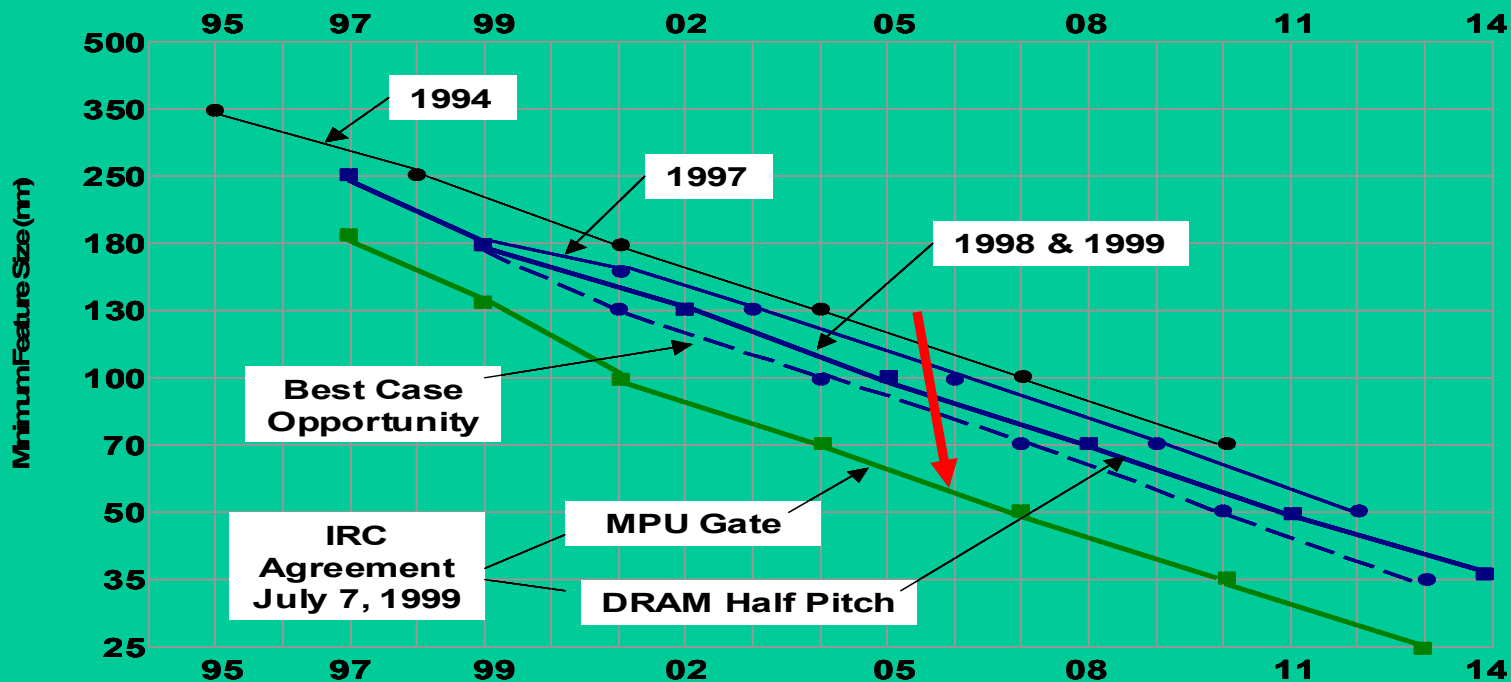
MOORE'S LAW



Source: <http://www.intel.com/research/silicon/mooreslaw.htm>

1b. Acceleration Management: Application to the Semiconductor Industry— change in "speed," cont'd

ITRS Roadmap Acceleration

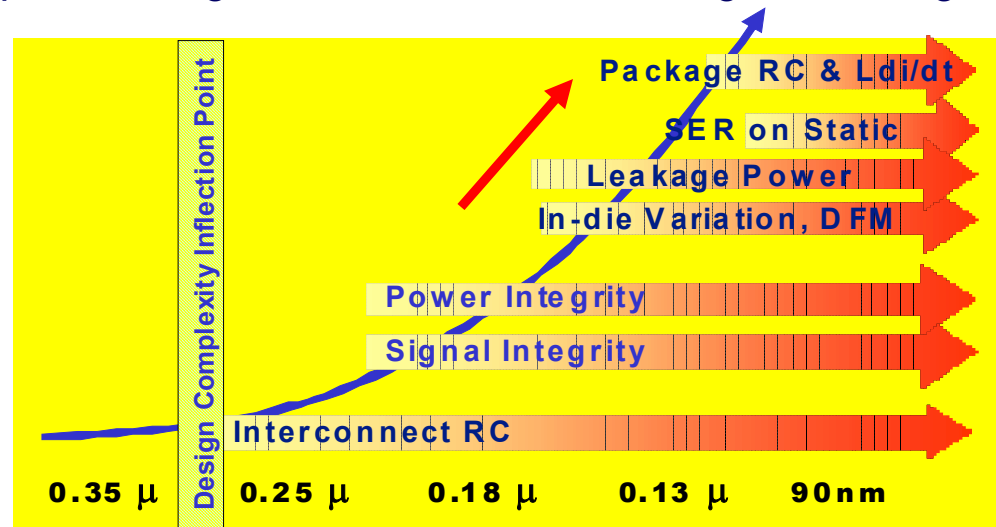


Source: <http://www.sematech.org/resources/ief/meetings/200011/itrs.pdf>

1b. Acceleration Management: Application to the Semiconductor Industry— change in "speed," cont'd

IPCore Technologies Confidential

Expert Design Solutions for Scaling Challenges



**Exponentially Increasing Design Complexity
Each generation**

IPCore

Page 1

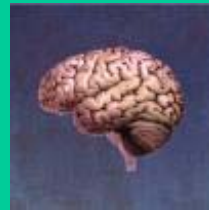
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1b. Acceleration Management: *Application to the Semiconductor Industry— change in “direction”*

(1) MultiCore Microprocessors

(a) Two “brains” instead of one

(b) While not twice as fast,
Intel and AMD want to
reduce power consumption
and heat dissipation



(2) 3D Memory Chips

(a) Like a layer cake instead of a
pancake

(b) Matrix uses older equipment to
make their 3D memories

1c. Acceleration Management:

7 Looming Technical Challenges

1. **Process Scaling** (interconnect complexity/in-die variation/separate clock domains/increase of leakage power/shrinking on-chip memories)
2. **Power Consumption Management** (increase in thermal density)
3. **Cost reduction and control** (fabs/products/masks/debugging)
4. **Product Complexity** (memory in the place of logic/predicting instructions)
5. **Performance Improvement** (more parallelism/more validation)
6. **Development Productivity** (design for reuse)
7. **Quality / Reliability** (relax design rules in less critical areas of chip)

(Technical details can be found in the paper)

1d. Acceleration Management: *Managerial Implications*

1. In the semiconductor industry, managerial imperatives have included:
 - a. *yield management*
 - b. *asset productivity improvement*
 - c. *pace-setting in new process development*
 - d. *coordination of multiple players involved with the technology roadmap*
 - e. *deciding when to "in-source" instead of outsource critical capabilities like mask-making*

1d. Acceleration Management: *Managerial Implications*

2. Acceleration Management accentuates the need for leadership in:

- a. *Securing access to deep technical knowledge*
- b. *Inspiring creative solutions to increasingly challenging technical problems*
- c. *Pooling and coordinating the necessary capabilities*
 - 1) *requires extensive inter-organizational cooperation along the supply chain*
 - 2) *the supply chain has increased in complexity with specialized firms (e.g., fabless design houses)*

1d. Acceleration Management: *Managerial Implications*

3. Overall, Acceleration Management accentuates the need to:

a. *pursue "disciplined creativity" where short-run decisions for technology and manufacturing planning take into consideration long-run needs*

1) *adopt design rules for current production processes that anticipate technical requirements of future process generations*

2) *improve methodologies (e.g., the hand-off to volume production like Intel's "copy exactly" approach; approaches to process verification or qualification; etc.)*

2. Entry Points for China-based Operations

1. Even in the face of Acceleration Management, a late entrant like China can make its mark

a. Manufacturing

1) 20 New Fabrication Facilities in China by 2008

a) some only ½ a technology generation behind state-of-the-art (0.15 μ instead of 0.13 μ)

b) 90nm fab in the works by Semiconductor Manufacturing International Corp. (SMIC)

2) Competitive Foundry Services—contract manufacturing

3) China-based fabs able to supply ~20% of China's \$31B IC market today (World IC market is roughly \$200B)

2. Entry Points for China-based Operations, cont'd

b. Design

1) Design Services—Intellectual Property (IP) Firms

a) ~500 fabless design houses by 2005

b) ~\$2.5B has been invested in IC design houses

c) opportunities in designing for: SIM&UIM cards in mobile phones / smart cards / audiovisual applications / security-oriented applications

2) Issue: protection of intellectual property rights

2. Entry Points for China-based Operations, cont'd

2. Enabled by:

a. government support

- 1) *the semiconductor industry was designated a key strategic industry*
- 2) *"In China, every province and city wants a design house and a fab...governors...are very happy to fund you."* (Source: IEE Review, October 2004)

b. the sheer number of engineering graduates

- 1) *~300,000 engineering graduates in 2004*

c. external expertise transferred through the return of expats and joint ventures

- 1) *embracing an open system of R&D and new process/product development*

3. Key Issues for China-based Operations in the Future

1. Intellectual property policy
2. Becoming a leader in technology rather than playing catch up
3. Can the open system of innovation substitute for domestic capability?
 - a. Export restrictions on advanced technologies and equipment
 - b. Ability to coordinate necessary resources and capabilities