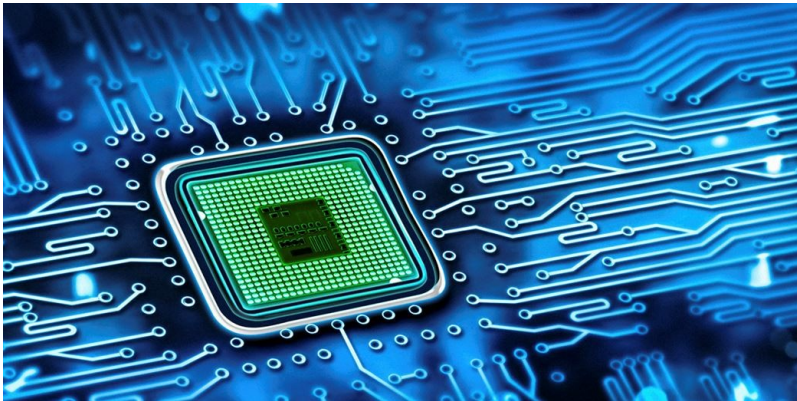


The Semiconductor Industry

Semiconductor Industry Association, International Technology Roadmap for Semiconductors, and the future of the semiconductor industry.



Jordan Ziwicki
12-10-21

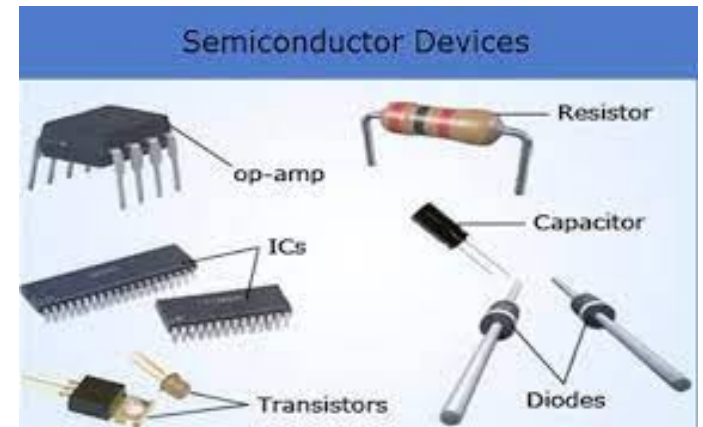
<https://citywireselector.com/news/who-really-stands-to-win-from-the-semiconductor-explosion/a1474985>

Outline

- Semiconductors Background
- Semiconductor Industry Association
- International Technology Roadmap for Semiconductors
- Semiconductor Industry: Current
- Semiconductor Industry: Future
- Summary
- References
- Possible Exam Topics/Questions

Semiconductors Background

- Many different devices
 - Reliable, low-cost, compactness
 - Easy integration
 - Easy to manipulate for desired results
- Si, GaAs, Ge, and organic materials
- Building blocks of logic gates



elprocus.com/semiconductor-devices-types-and-applications/

Semiconductor Industry Association (SIA)

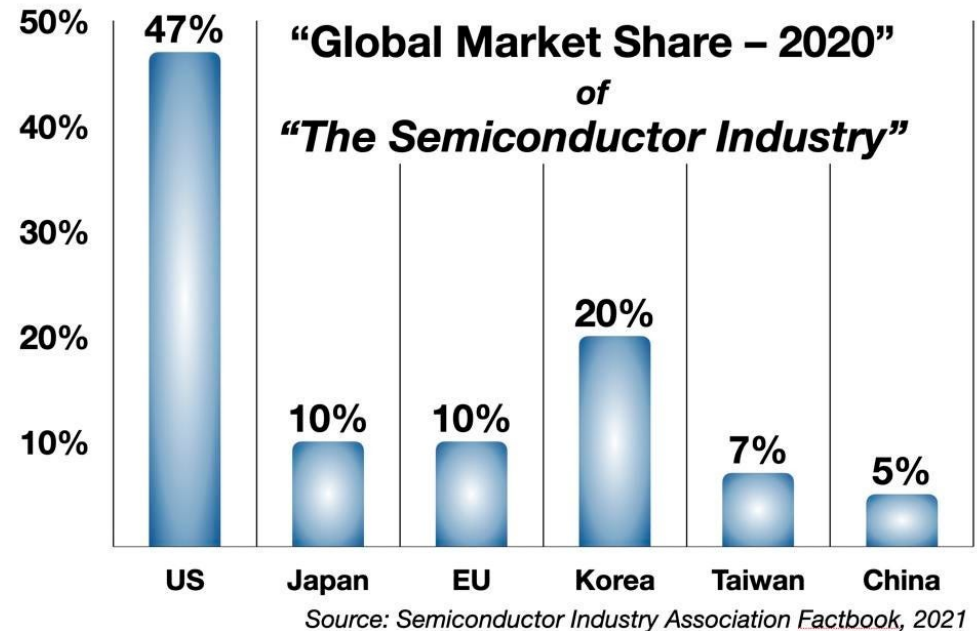
- Founded in 1977
 - Wilfred Corrigan, Robert Noyce, Jerry Sanders, Charles Sporck, John Welty
- Created the first National Technology Roadmap for Semiconductors (1993)
- Unites companies that make up 80% of Americas production of semiconductors

Characteristic	1992	1995	1998	2001	2004	2007
Feature size (microns)	0.50	0.35	0.25	0.18	0.12	0.10
Gates per chip (millions)	0.3	0.8	2.0	5.0	10.0	20.0
Bits per chip						
DRAM	16M	64M	256M	1G	4G	16G
SRAM	4M	16M	64M	256M	1G	4G
Wafer processing cost (\$/cm ²)	\$4.00	3.90	3.80	3.70	3.60	3.50
Chip size (mm ²)						
logic	250	400	600	800	1,000	1,250
memory	132	200	320	500	700	1,000
Wafer diameter (mm)	200	200	200-400	200-400	200-400	200-400
Defect density (defects/cm ²)	0.10	0.05	0.03	0.01	0.004	0.002
Levels of interconnect (for logic)	3	4-5	5	5-6	6	6-7
Maximum power (watts/die)						
high performance	10	15	30	40	40-120	40-200
portable	3	4	4	4	4	4
Power supply voltage						
desktop	5	3.3	2.2	2.2	1.5	1.5
portable	3.3	2.2	2.2	1.5	1.5	1.5

https://en.wikipedia.org/wiki/Semiconductor_Industry_Association

Semiconductor Industry Association (cont.)

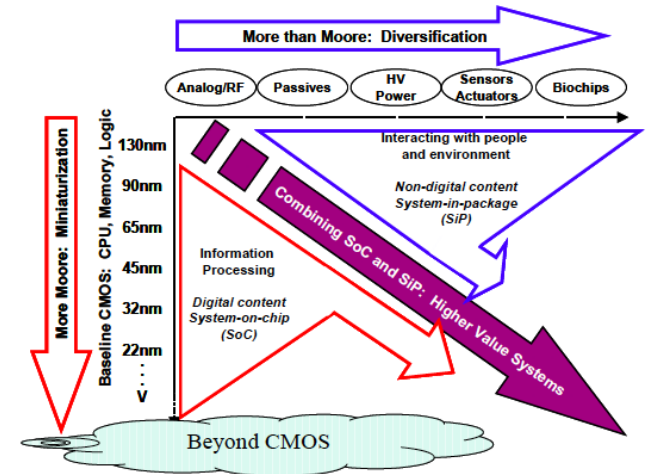
- Voice of the U.S. semiconductor industry
 - One of U.S. top export industries
- Strengthen manufacturing, design, and research in U.S.
 - Encourage policies and regulations that help the U.S. compete



<https://cset.georgetown.edu/article/in-semiconductors-china-is-in-commodity-hell-part-4/>

International Technology Roadmap for Semiconductors (ITRS)

- Created in 1998
 - SIA
 - Connect to European, Japanese, Korean, Taiwanese counterparts
 - Cost-effective advancements within the industry
- As of 2003, 936 companies work within the ITRS
- Industry growth led to specialized machines being required
 - Different companies make different specialized products
- Set of documents that act as a guideline
 - 15 year plan, updated in even years, revised in odd years
- In 2005, posted paper on “More than Moore” (MtM) and “More Moore” (MM)



<https://irds.ieee.org/>

ITRS

- Divided into 17 Technical Working Groups (TWG)
 - Focus on key elements of the technology as well as the supply chain of the industry
- Latest publish was in 2013
 - Focused on methodology and physics behind scaling
- ITRS 2.0
 - April 2014
 - 17 TWGs into 7 focus topics
- Led to the creation of the International Roadmap for Devices and Systems (IRDS) in 2016
 - Final Roadmap for ITRS in 2016, dealing with Moore's Law as it approaches its possible demise
 - IRDS focused on more than MOS devices and had a broader approach to system integration
 - Sponsored by IEEE in May 2016

ITRS 2.0

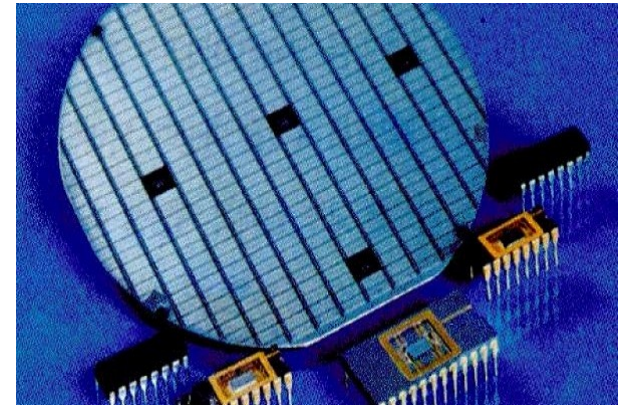
- System Integration
 - Examines architecture and integration of heterogeneous blocks
- Outside System Connectivity
 - Wireless technologies, how they work and when to use them
- Heterogeneous Integration
 - Integration of separately manufactured pieces into new units
- Heterogeneous Components
 - Devices that form heterogeneous systems (MEMS, power generation, sensing devices)
- Beyond CMOS
 - Devices that provide electronics, non-CMOS based
- More Moore
 - Focuses on Moore's Law and attempting to continue the progress of the shrinking of CMOS
- Factory Integration
 - New tools and processes to produce heterogeneous integration



<https://www.businesswire.com/news/home/20210730005109/en/ITRS-Group-Continues-Expansion-With-the-Acquisition-Of-Opsview>

Semiconductor Industry: Current

- Covid Pandemic
 - Large growth of the semiconductor industry
 - Need for remote access for work, shopping, living life etc.
 - Use of semiconductors in the medical field
 - Mass production of vaccines/treatments
 - Rise in demand for semiconductors led to shortage
 - Demand for the pandemic response
 - Chip shortages for cars



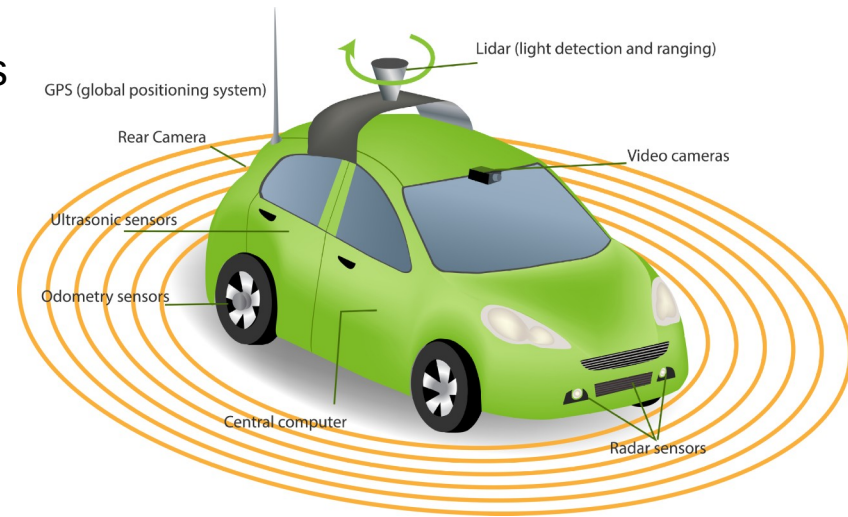
<https://www.electronicmedia.info/2018/01/27/ranking-to-p-10-semiconductor-chip-buyers-companies-gartner/>

Semiconductor Industry: Current (cont.)

- More shipments of semiconductors on a monthly basis than ever before (summer 2021)
 - Help reach the level of demand
 - Linger into 2022
- In 2019, 100% of the world's logic semiconductors (<10nm) were produced overseas
 - Investments in U.S. chip production and innovation
 - United States Innovation and Competition Act (USICA, June 2021)
 - \$52 billion towards domestic chip design, manufacturing, and research

Semiconductor Industry: Current (cont.)

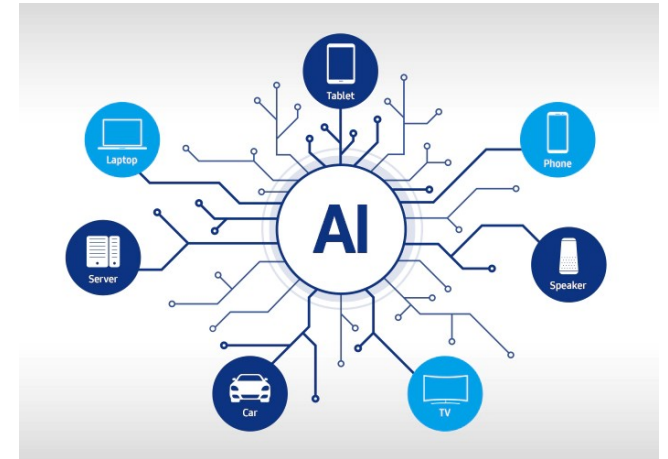
- Automotive Industry
 - Cars are becoming more and more electronic
 - Hybrid and electric rely heavily on semiconductors
 - Increase in the implementation of AI in cars
 - Advanced Driver-Assistance Systems (ADAS), LiDAR
 - Assistance while driving through sensing, computing and storage/memory, and infotainment
 - 5x times the semiconductors are required for a fully autonomous vehicle compared to a partially automated equivalent



<https://innovationatwork.ieee.org/lidr-is-the-latest-game-changing-advancement-for-autonomous-vehicles/>

Semiconductor Industry: Future

- Short-term problems may persist with the shortage of chips
- In the long-term, the semiconductor industry should stabilize and continue to grow
 - Communications, data processing, automotive
 - Continued growth of AI will increase demand for chips in everything we use



<https://www.samsung.com/semiconductor/newsroom/tech-leadership/bringing-artificial-intelligence-to-devices-everywhere/>

Summary

- SIA
 - Unites Americas top semiconductor companies
 - Maintain the competitive edge that the U.S. has over other countries in the semiconductor industry
 - Created the International Technology Roadmap for Semiconductors
- ITRS
 - Documents that act as a guideline for the future of the semiconductor industry
 - 15 year plan
 - ITRS (1998) → ITRS 2.0 (2014) → IRDS (2015)
- Currently a shortage of chips
 - Extremely high demand, growing industries that require semiconductors
 - Covid-19
- Future holds promising growth after shortage of chips solution is found
 - Communications, automotive, data processing, AI, etc.

References

- <https://www.semiconductors.org/policies/overview/>
- <https://www.semiconductors.org/wp-content/uploads/2021/09/2021-SIA-State-of-the-Industry-Report.pdf>
- https://en.wikipedia.org/wiki/Semiconductor_Industry_Association
- http://mail.indosingo.com/IT/en/117-13/International-Technology-Roadmap-for-Semiconductors_2496_mail-indosingo.html
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- <http://www.itrs2.net/>
- <https://www.azom.com/article.aspx?ArticleID=20394#:~:text=The%20Future%20of%20Semiconductors,data%20processing%2C%20and%20automotive%20sectors>
- elprocus.com/semiconductor-devices-types-and-applications/
- <https://irds.ieee.org/>

Possible Exam Topics/Questions

- What are the seven topics that ITRS 2.0 focuses on and give a brief description of each?
- Explain what the Semiconductor Industry Association is and what it helps to do.
- Why did the SIA create the ITRS?
- Name three fields in the semiconductor industry that have shown growth over the last 10 years and will continue to show growth.
- What took place of the ITRS and why do you think that is?