



Unleash Innovation

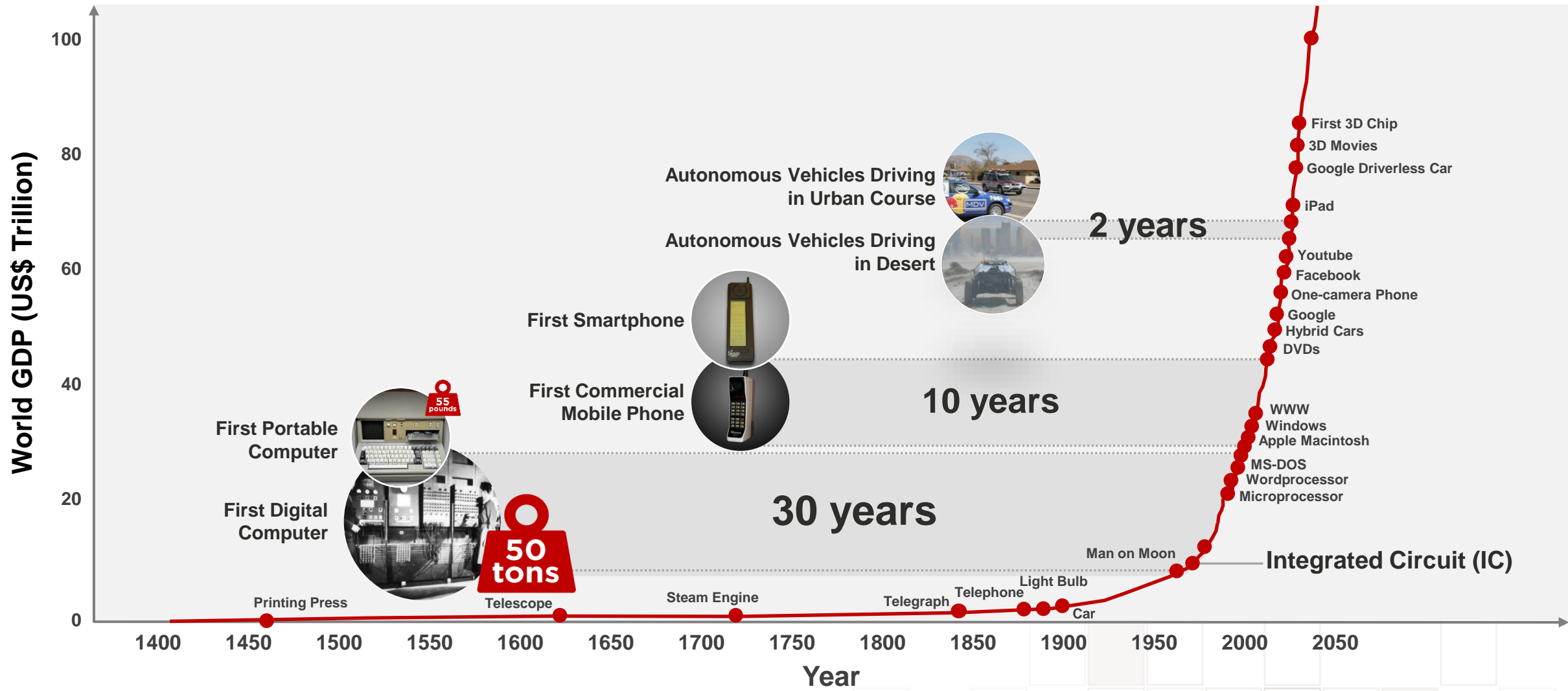
# The Semiconductor Industry Transforming Our World

# Outline



- **The Amazing History of Semiconductors**
- **TSMC: Our History and How We are Changing the World**
- **TSMC: Our AZ 5nm Fab and Career Opportunities**

# Society Embraces Technology Advancements



Source: World GDP – Our World In Data based on World Bank & Maddison (2017); Images from Wikipedia; Sandstein; Redrum0486;

# The “Law” Behind the Revolution

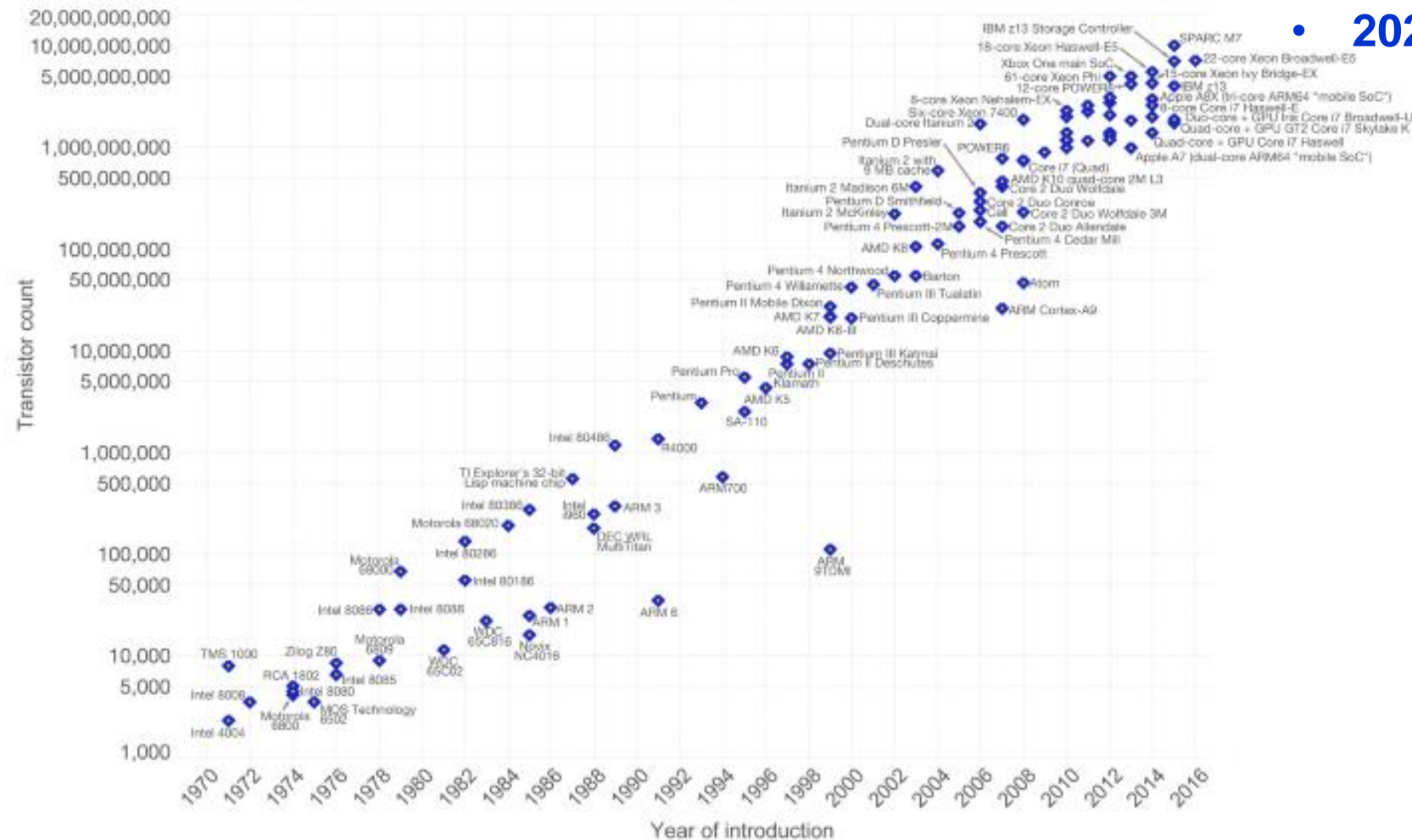


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## Moore's Law – The number of transistors on integrated circuit chips (1971-2016)



Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are strongly linked to Moore's law.



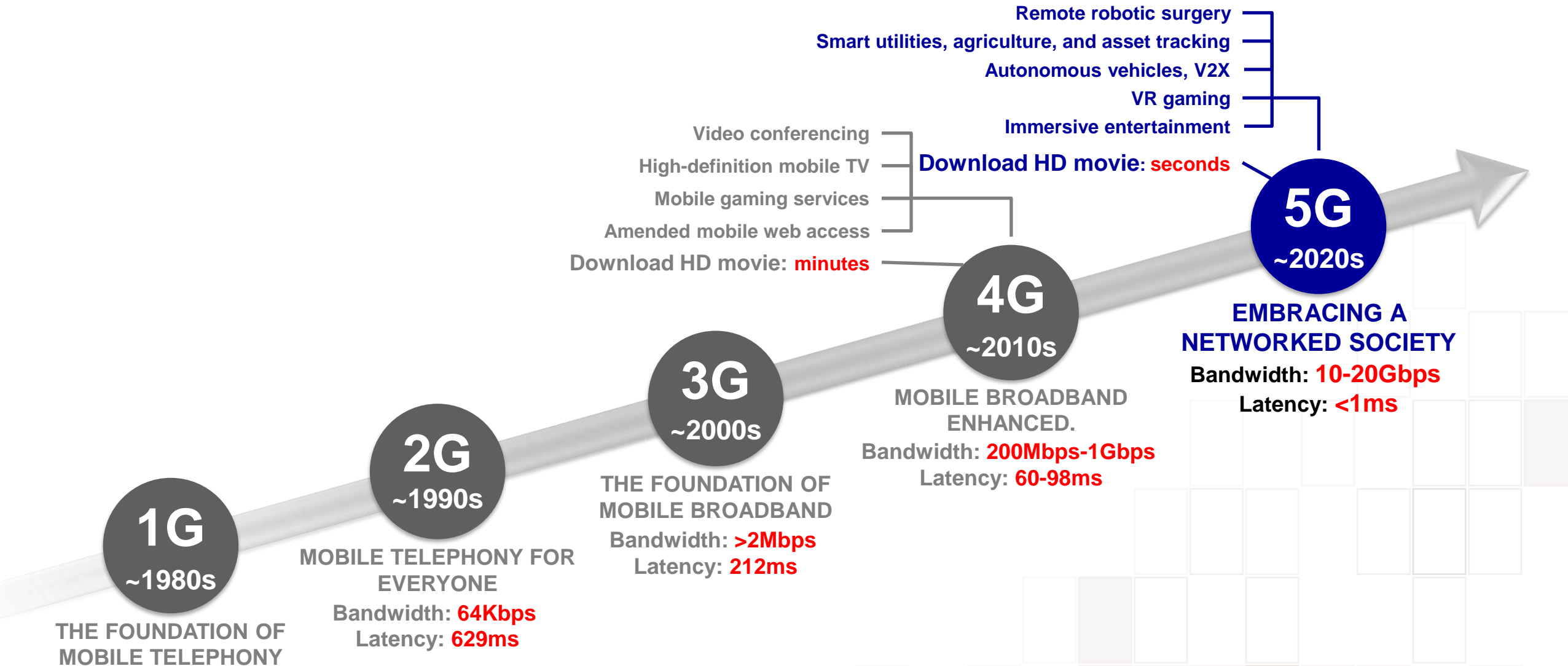
• 2020 10+ Billion

Data source: Wikipedia ([https://en.wikipedia.org/wiki/Transistor\\_count](https://en.wikipedia.org/wiki/Transistor_count))

The data visualization is available at [OurWorldinData.org](https://www.ourworldindata.org). There you find more visualizations and research on this topic.

Licensed under CC-BY-SA by the author Max Roser.

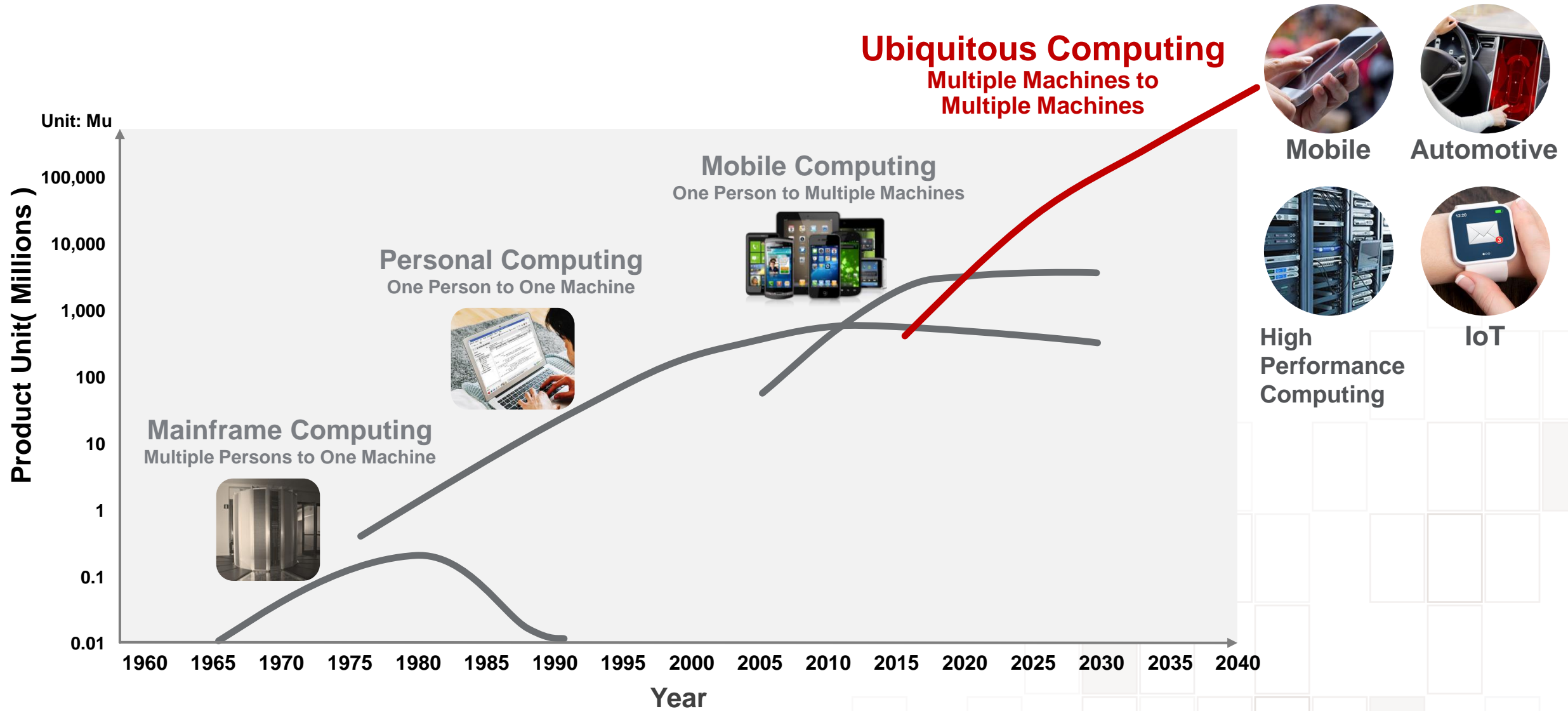
# Evolution of Mobile Communication



Source: CISA, IJMTET, Net-informations.com, gonorthforge.com, raconteur.net



# Semiconductor Adoption Trends



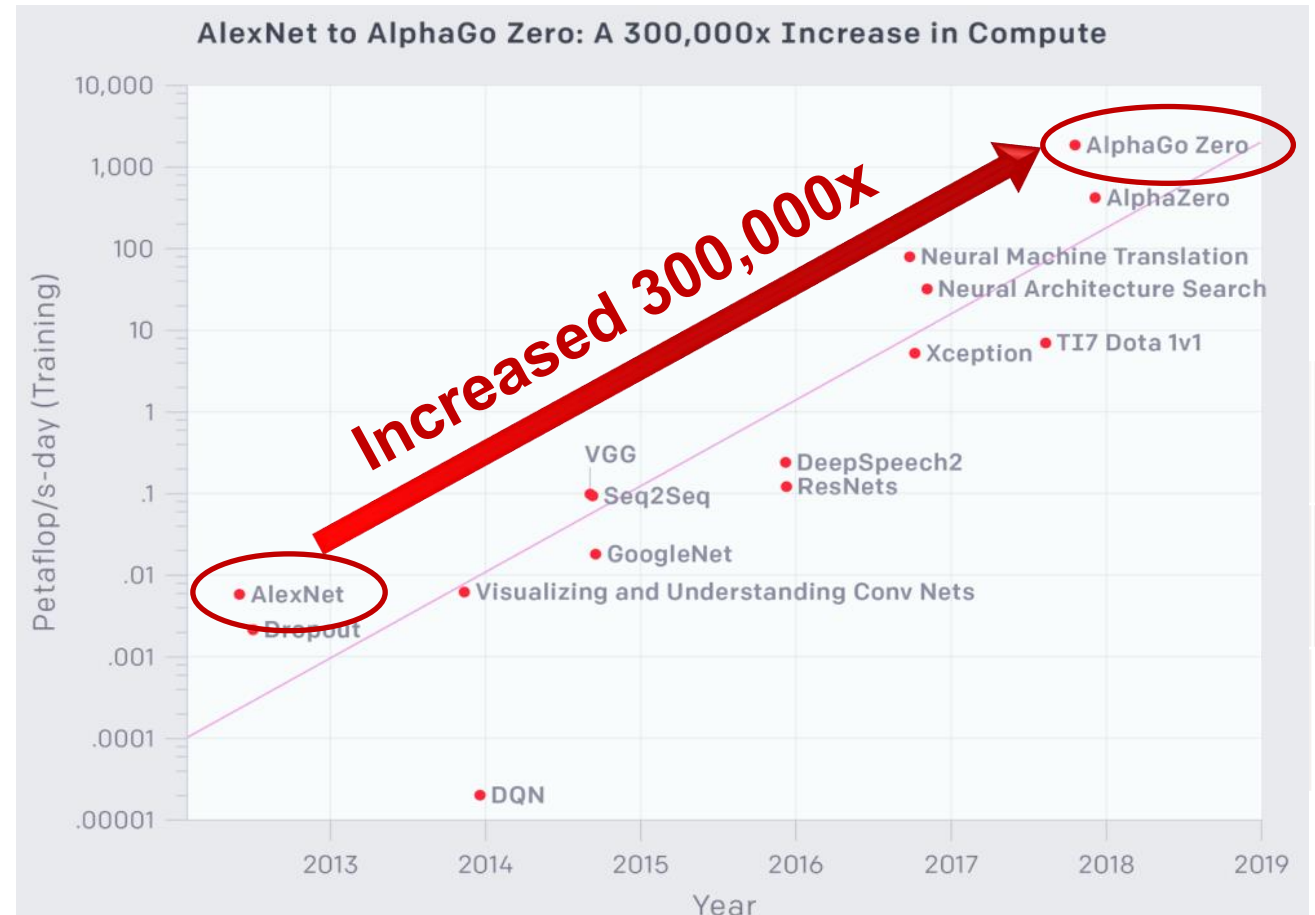
# Explosive BIG DATA Requires Insatiable Computing

## Digital Data Boom

Application	Data generated per day
Internet User	1.5GB ( $10^9$ )
Autonomous Car	4TB ( $10^{12}$ )
Connected Aircraft	5TB ( $10^{12}$ )
Smart Factory	1PB ( $10^{15}$ )
Video Communication Service Provider	750PB ( $10^{15}$ )

Source: IDC

## Rise in AI Computing Power

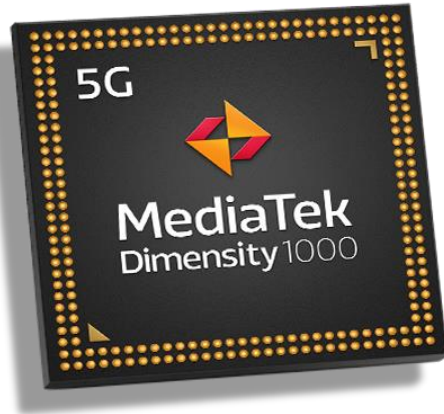


Source: OpenAI, Alibabacloud.com

# Democratizing Most Advanced Logic Technology to Unleash More Innovation



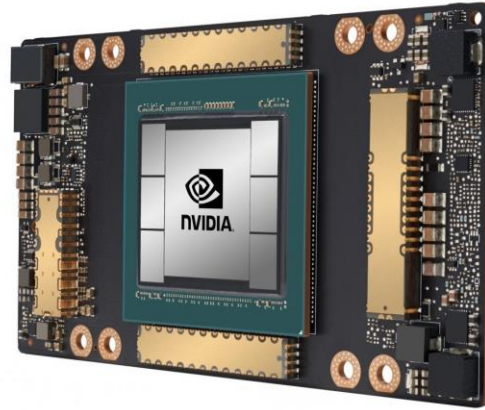
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**7nm 5G MediaTek Dimensity™ 1000**

**~2x**  
PERFORMANCE

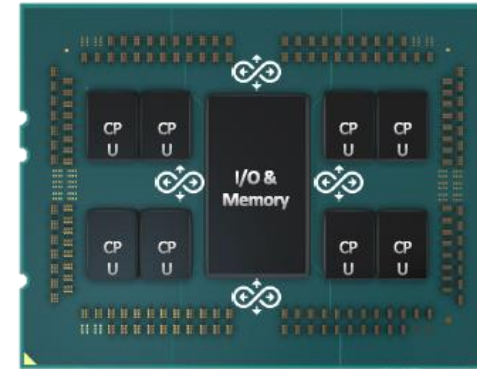
**~8x**  
DOWNLOAD  
SPEED



**7nm NVIDIA A100 Tensor Core GPU**

**1/10<sup>th</sup>**  
COST

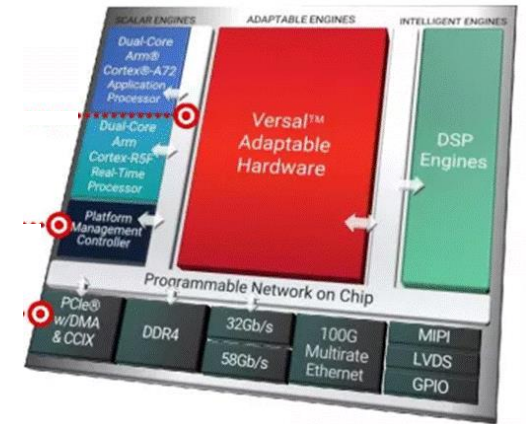
**1/20<sup>th</sup>**  
POWER



**7nm EPYC™ Gen2 Processor**

**>2x**  
PERFORMANCE  
OR

**50%**  
POWER  
REDUCTION

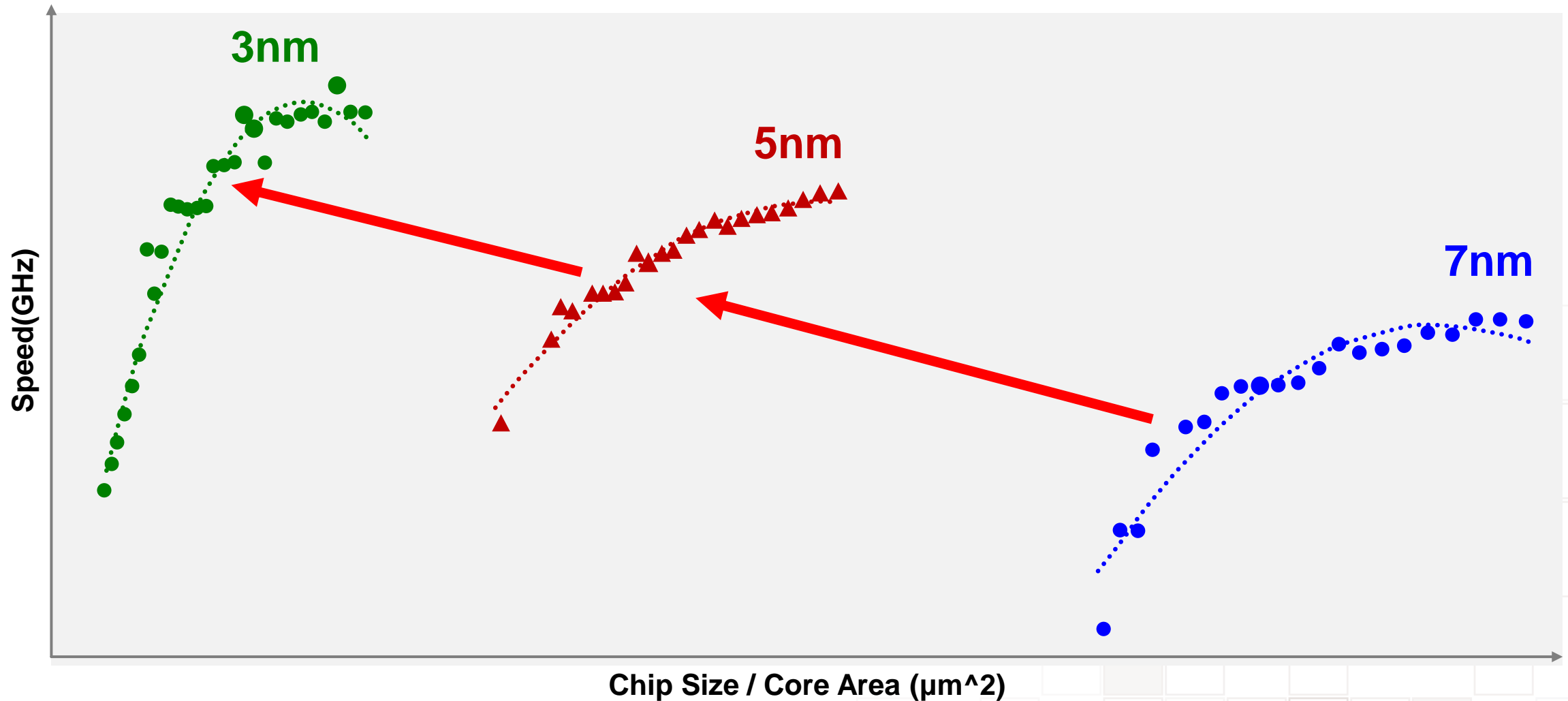


**7nm Xilinx Versal™ ACAP**

**22**  
Equivalent 16nm FPGAs



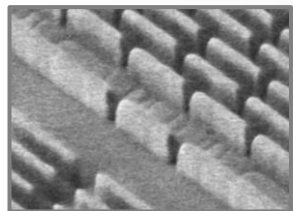
# Technology Innovation Drives Energy Efficiency



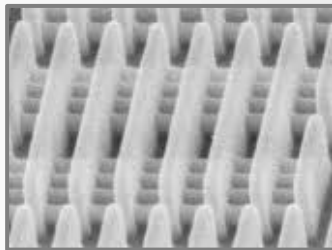
Source: TSMC

# Transistor Scaling with Innovations

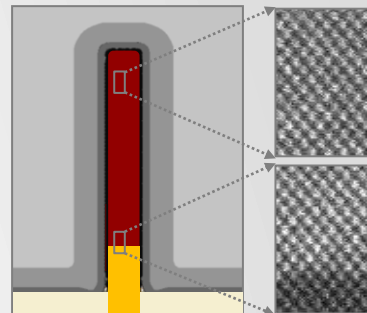
- New transistor structures (FinFET, Nanosheet/ Nanowire ...)
- New transistor materials (High mobility channel, 2D, CNT...)



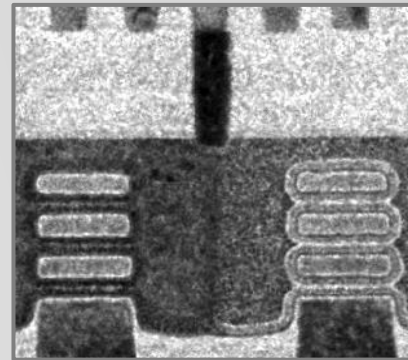
Planar



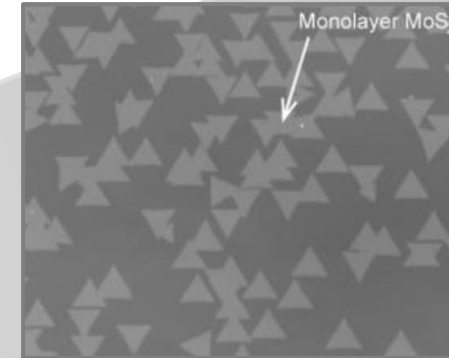
FinFET



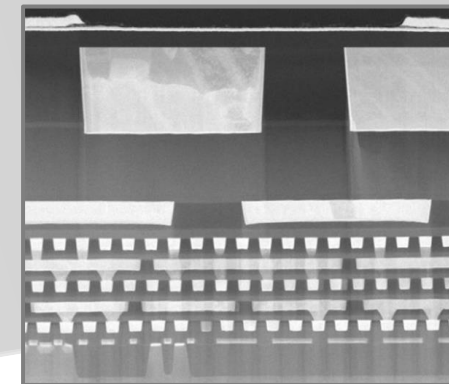
High mobility channel



Nanosheet / Nanowire



2D Materials



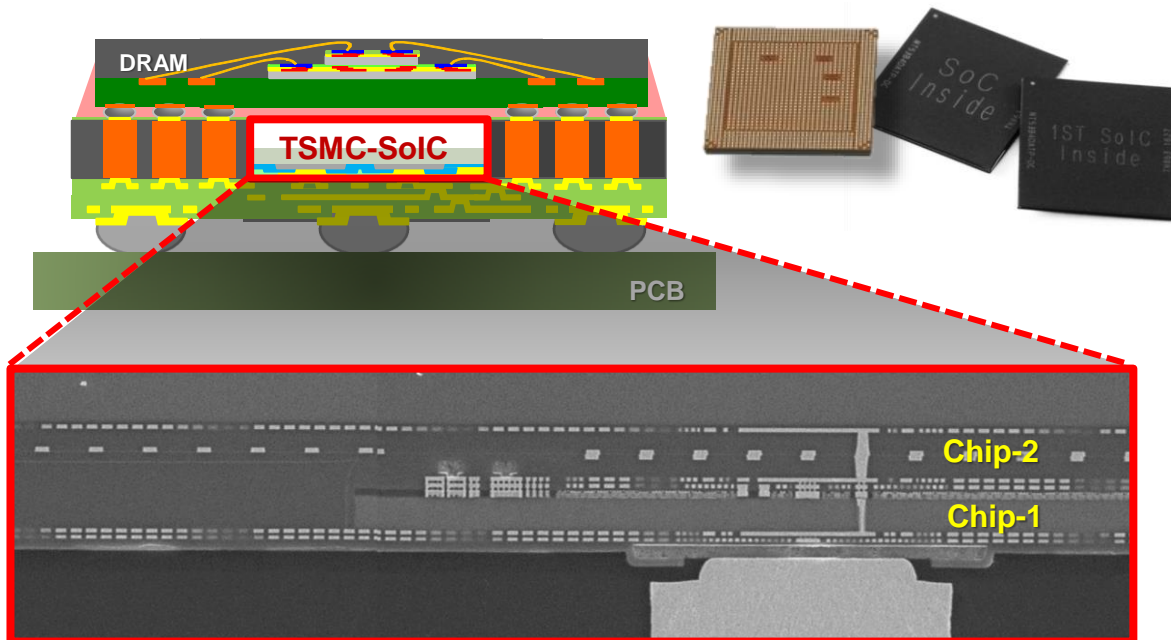
Carbon Nanotube

**SMALLER  
MORE  
ENERGY  
EFFICIENT**

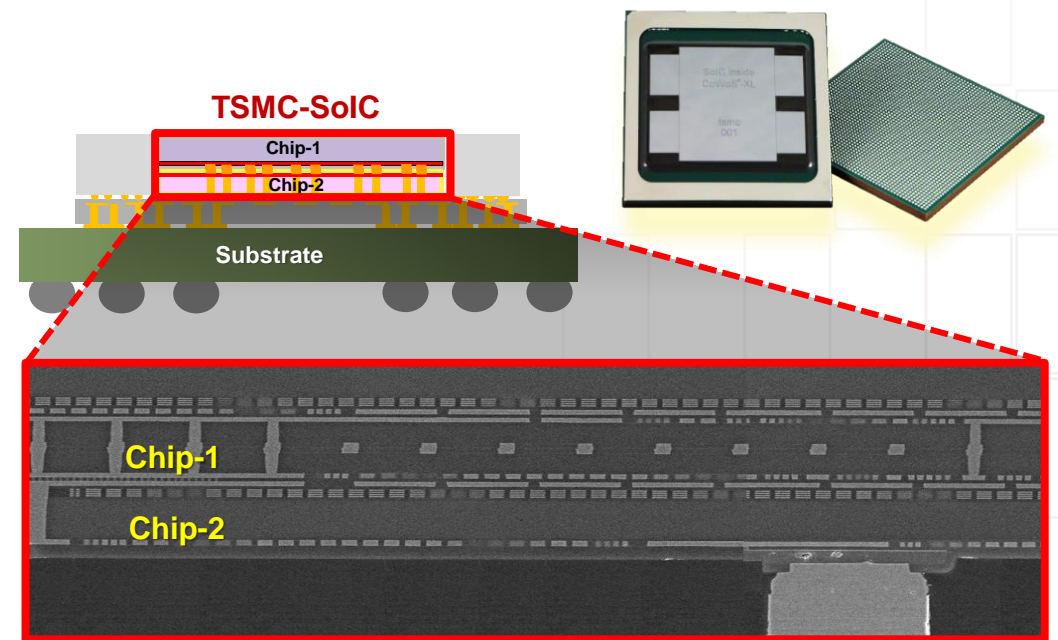
# Innovative System Integration



## FE 3D + BE 3D Integration for Mobile



## FE 3D + BE 3D Integration for HPC





**Our mission is to be the trusted technology and capacity provider for the global logic IC industry for years to come.**



# The Foundry Semiconductor Business



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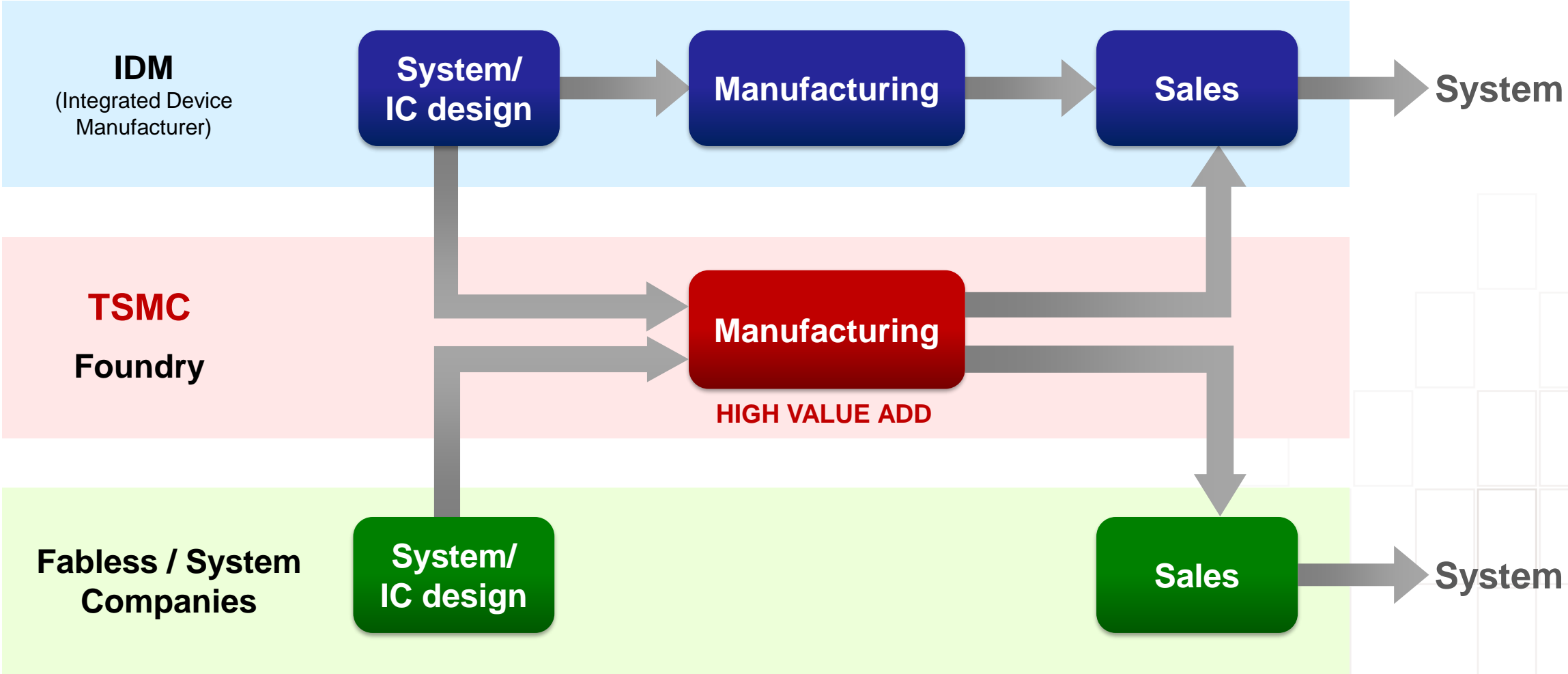


“ *When he founded TSMC in 1987, Morris Chang recalls, ‘Nobody thought we were going anywhere.’ Back then the rule was that semiconductor companies both designed and made chips. TSMC was the first pure ‘foundry’, making chips for designers with no factories, or ‘fabs’, of their own.* ”

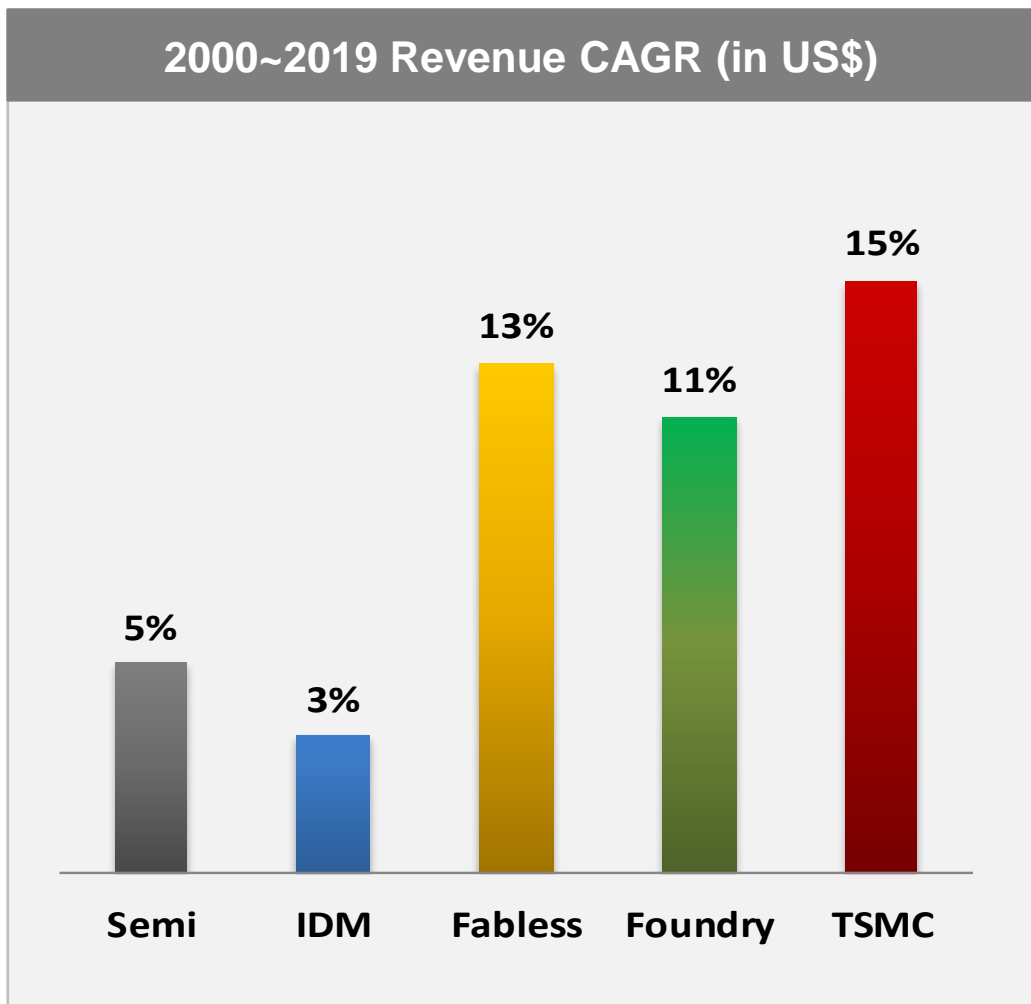
- 30 years ago most companies designed and manufactured their own products “IDM.”
- The economics of advanced Silicon manufacturing has changed radically over the last 20 years.
- WHY? Building an advanced fab for chip manufacturing requires **tens billions** of dollars as well as deep investment and development of extraordinary talent — where you come in — to operate the facility.
- Many of the companies who design semiconductors now depend on third parties to manufacture their products
- Today, fabless semiconductors represent 30% of the overall \$433 billion semiconductor business and is growing rapidly



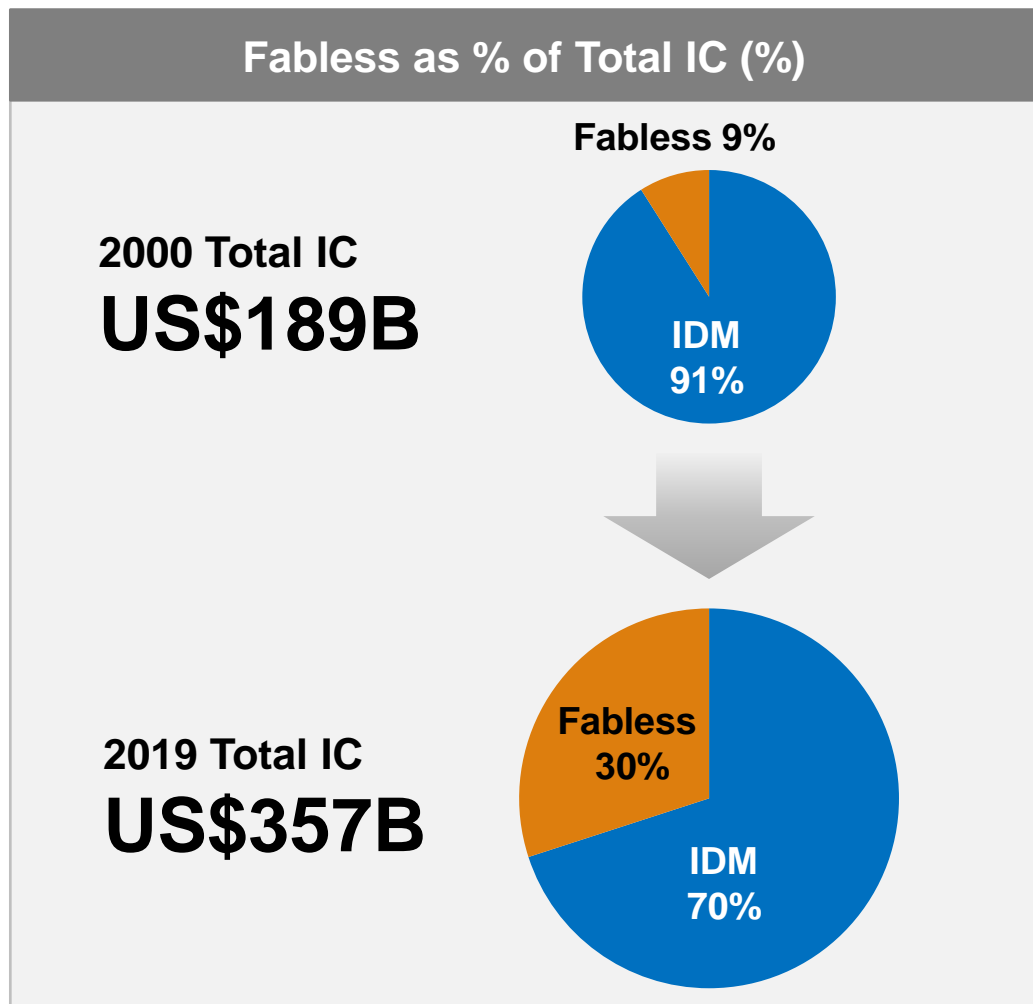
# TSMC Manufacturing Platform enables innovation



# Foundry/Fabless Business Model is a Winning Combo



Source: WSTS, GSA, IC Insight, TSMC



# TSMC's Collaborative Business Model Changed the Industry's Landscape: Top 10 Semiconductor Companies Reshuffled

2000 Rank	Company	Type
1	Intel	IDM
2	Toshiba	IDM
3	NEC	IDM
4	Samsung	IDM
5	TI	IDM
6	Motorola	IDM
7	STM	IDM
8	Hitachi	IDM
9	Infineon	IDM
10	Philips	IDM

2019 Rank	Company	Type
1		IDM
2		IDM
3	<b>TSMC</b>	<b>Foundry</b>
4	SK Hynix	IDM
5	Micron	IDM
6	Broadcom	Fabless
7	Qualcomm	Fabless
8		IDM
9	Nvidia	Fabless
10		IDM

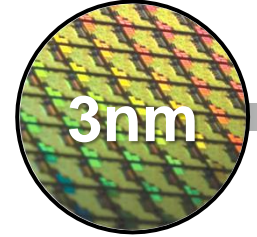
Source: McClean Report 2020, IC Insights

# Value Proposition



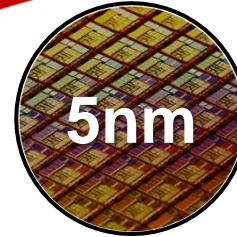
# TSMC Leads in Advanced Logic Technology

Continue to Lead in  
Advanced Logic Technology



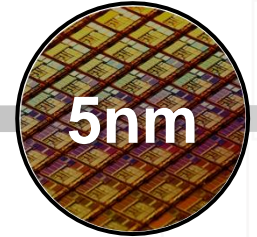
3nm

DEVELOPMENT  
ON TRACK



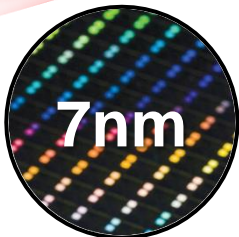
5nm

INDUSTRY'S FIRST DESIGN  
ECOSYSTEM + RISK PRODUCTION



5nm

INDUSTRY'S FIRST  
VOLUME PRODUCTION



7nm

INDUSTRY'S FIRST DESIGN  
ECOSYSTEM + RISK PRODUCTION

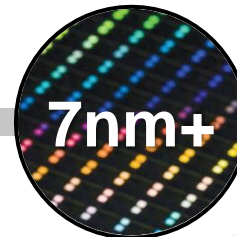
2017



7nm

INDUSTRY'S FIRST  
VOLUME PRODUCTION

2018



7nm+

INDUSTRY'S FIRST EUV  
VOLUME PRODUCTION

2019



7nm

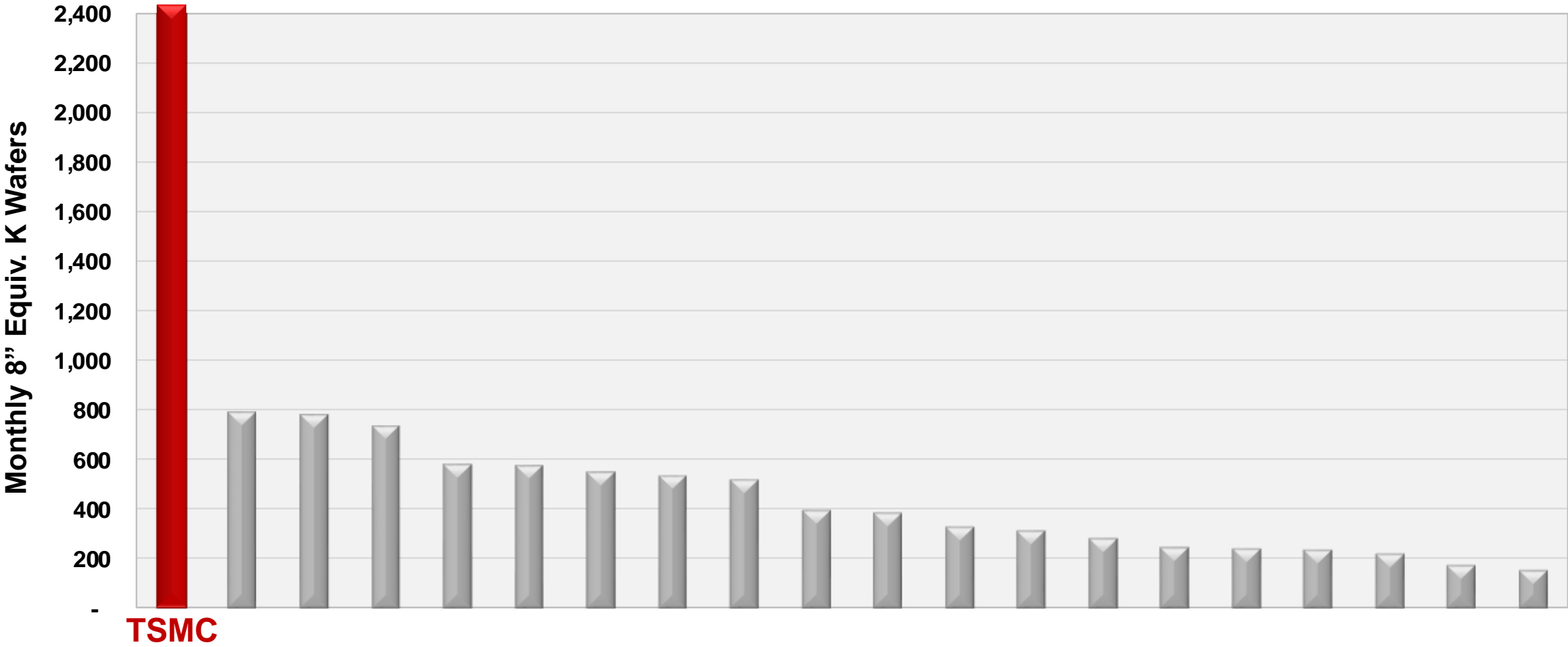
1 BILLION  
CHIPS SHIPPED

2020



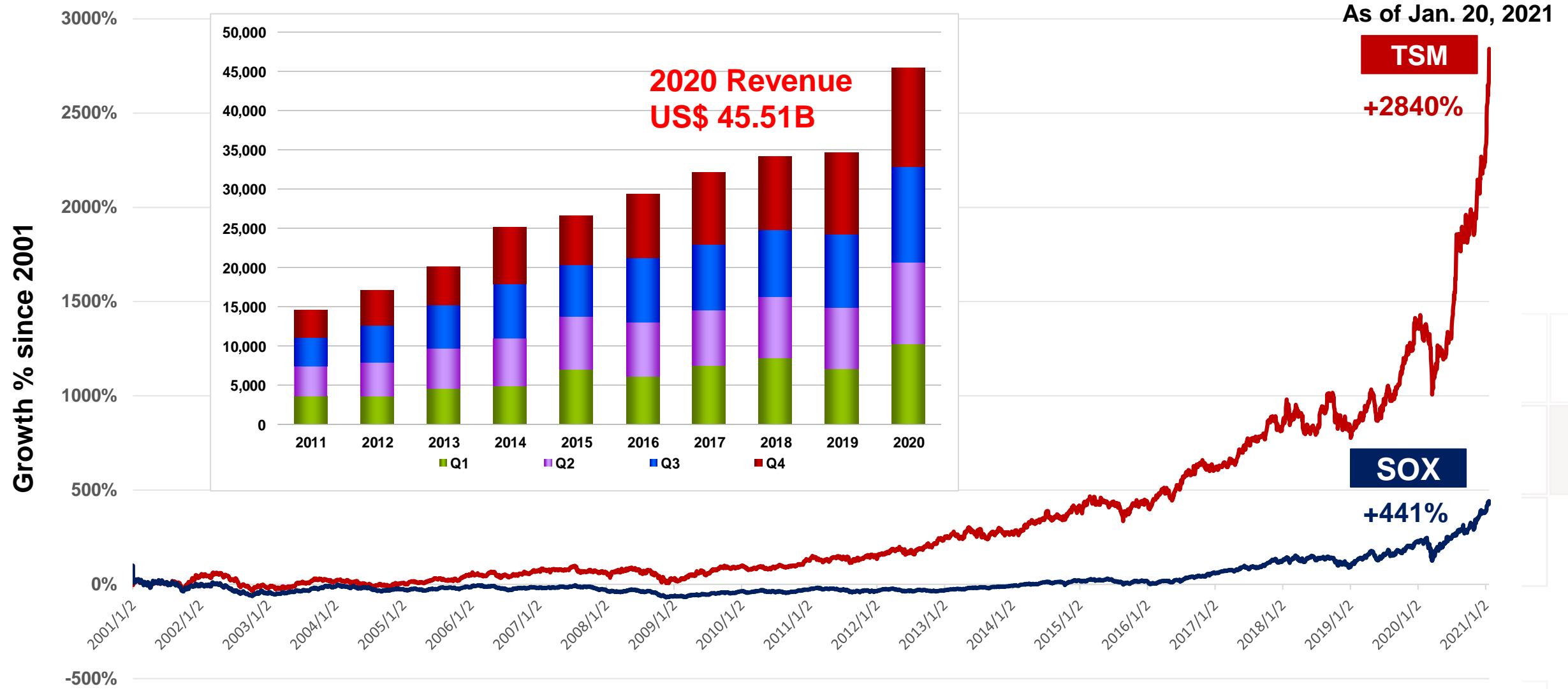
# TSMC Leadership in Semiconductor Manufacturing

2020 Worldwide Top 20 Semiconductor Companies' Installed Capacity (Excl. Memory)



Source: SEMI

# TSMC Stock Performance vs. SOX



# One last item, Sustainability

- **We are the world's first semiconductor firm to join the RE100 initiative — a global initiative bringing together the world's most influential businesses committed to 100% renewable electricity.**
- **And we've implemented over 500 energy saving measures that have resulted in:**
  - 160,000 metric tons of carbon dioxide emissions eliminated
  - \$26.6 million in utility fees saved
  - Potential external carbon costs reduced by \$8.5 million
- **We're not resting on our laurels. We've committed to 100% renewable energy and zero indirect carbon emissions from electricity consumption by 2050.**



# TSMC: Our AZ 5nm Fab and Career Opportunities



Source: <https://www.pbs.org/newshour/politics/what-to-watch-in-arizonas-special-election>



# TSMC Leading-edge 5nm Fab in Phoenix, Arizona


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DESIGNLINES | SOC DESIGNLINE

## TSMC to Build 5nm Fab in Arizona

By Alan Patterson 05.15.2020 4

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Taipei – Taiwan Semiconductor Manufacturing Co.(TSMC) said it will build a 5nm fab in Arizona with support from that state and the U.S. federal government.


The facility will have a 20,000 wafer-per-month capacity, create over 1,600 jobs directly and thousands more indirect jobs, the company said in a press statement today.

The announcement comes following press reports that the U.S. government was pushing TSMC to build a fab in America. As the U.S. aims to impede China’s growth in the technology industry, TSMC faces potential U.S. restrictions on sales of its most advanced chips to Chinese companies such as Huawei, the world’s second-largest smartphone maker.

“TSMC’s motivation in building a U.S. fab is to gain favor with the United States administration,” Wedbush Securities Senior



Friday, November 13, 2020



## The Burn-In

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Industry

## TSMC will spend \$3.5 billion to establish a subsidiary in Arizona

By Mario McKellop - November 12, 2020 46 0

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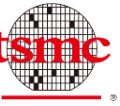


# Reasons to Move to Phoenix

- Metro Population: 4,673,634
- Median Age: 36.4
- Average High/Low Temps: 86.6° / 63.4°
- Average days of sunshine: >300 days
- Average Commute Time: 26.4 minutes
- Rank #3 best city for 1<sup>st</sup> time home buyers
- Rank #4 most desirable city for millennials
- Rank #5 largest city in USA
- Rank #11 best place to start a business
- Largest population increase in the US in 2018
- Top 10 Best Children's Hospital in the U.S.
- 5 professional sports teams (NFL, NBA, WNBA, MLB, NHL)
- Nationally ranked Phoenix area high schools include: BASIS Chandler #7, BASIS Peoria #27, BASIS Scottsdale #49, BASIS Phoenix, Gilbert Classical Academy #60, BASIS Ahwatukee #67, University High School (Tolleson) #86
- Best Cities for an Active Lifestyle include: Tucson #27, Scottsdale #34, Glendale #39, Phoenix #46, Gilbert #62, Chandler #72 and Mesa #81



# Career Opportunities in Arizona Fab



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*Scan here to explore the opportunities!*

## We're seeking

- **Candidates for:**

- Process Integration Engineer
- Yield Enhancement Engineer
- Equipment Engineer
- Equipment Technician
- Module Process Engineer
- Manufacturing Supervisor
- Facility Electrical Engineer
- Facility Instrumentation and Control Engineer
- Facility Mechanical Engineer
- Facility Process Gas and Chemical Engineer
- Facility UPW and Water Process Engineer

- **Major (BS/MS/Ph.D.) in:**

- Electrical Engineering
- Materials Science
- Chemical Engineering
- Chemistry
- Physics
- Mechanical Engineering
- Computer Science



**On board in 2021**



# Training in Taiwan



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Source: <https://www.freepik.com/free-photos-vectors/taiwan-map>

- Your TSMC journey starts first with a 12- to 18-month training program in Tainan, Taiwan at Fab 18.
- An opportunity to be fully immersed in the most leading 5nm Giga fab to apply your training to solve real world problems
- Return back to Phoenix with your expert knowledge to bring TSMC Arizona Fab to roar to life
- You'll also have the chance to soak up the culture and bond with your new colleagues
- Housing accommodations & Travel will be covered





*Scan here to explore the opportunities!*

# Join us, Brilliant together!



## Q&A

Email to:  
Charles Chu / [cchux@tsmc.com](mailto:cchux@tsmc.com)  
April Tseng / [april\\_tseng@tsmc.com](mailto:april_tseng@tsmc.com)