

# VLSI

<Video>

Semiconductors Power

→ electronics we use

↳ Foundries that make them

"We need to stop playing catch-up"

Covid-19 → Massive Global Shortage.

# Biden took action (look for Japs in h<sub>h</sub> industry in the U.S.)

- The shift towards 'PaaS' is one reason.

The U.S. Chip industry

47% only 12%  
Global h<sub>h</sub> Sales due to chip manufacturing

\* Total Sales \$439B For 2020 (globally)

- Cars getting more advanced is another big reason. 118.3% growth

↳ need more h<sub>h</sub>

↳ even non-advanced features like Power steering need h<sub>h</sub>

↳ Controls manufacturing

\* Need more chips

in 2021 → 5G, IOT, remote solutions.

⇒ China is trying to be self-sufficient but the U.S. is only making it harder

Design + Manufacture

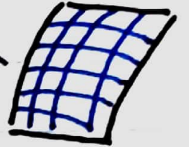
The no. 1 Pure chip Foundry is actually TSMC in Taiwan

↳ Unlike China's Huawei no probs with U.S.

The U.S. needs the ability to make leading node chips  
So it can control the whole industry.\*  
</Video>

VLSI Stands For Very Large Scale Integration

Very large  
(massive)  
no. of  $\mu$  in  
a single chip.



## Learning Outcomes

Industry & Economics

Digital Design Technologies

VLSI Design Flow

Design Metrics, trade-offs & issues

Reusing Intellectual Property (IP)

Includes diff. tools through the Flow Simulation  $\rightarrow$   $\mu$  level circuit

$\rightarrow$  Area, delay, Power

Contradicting metrics.  
Sweet Spot?

Improves design Speed Cycle.

## Design

Digital

Analog

RF (Radio Freq.)



e.g. Transmitters, Amplifiers

Antennas, Wireless Transmission

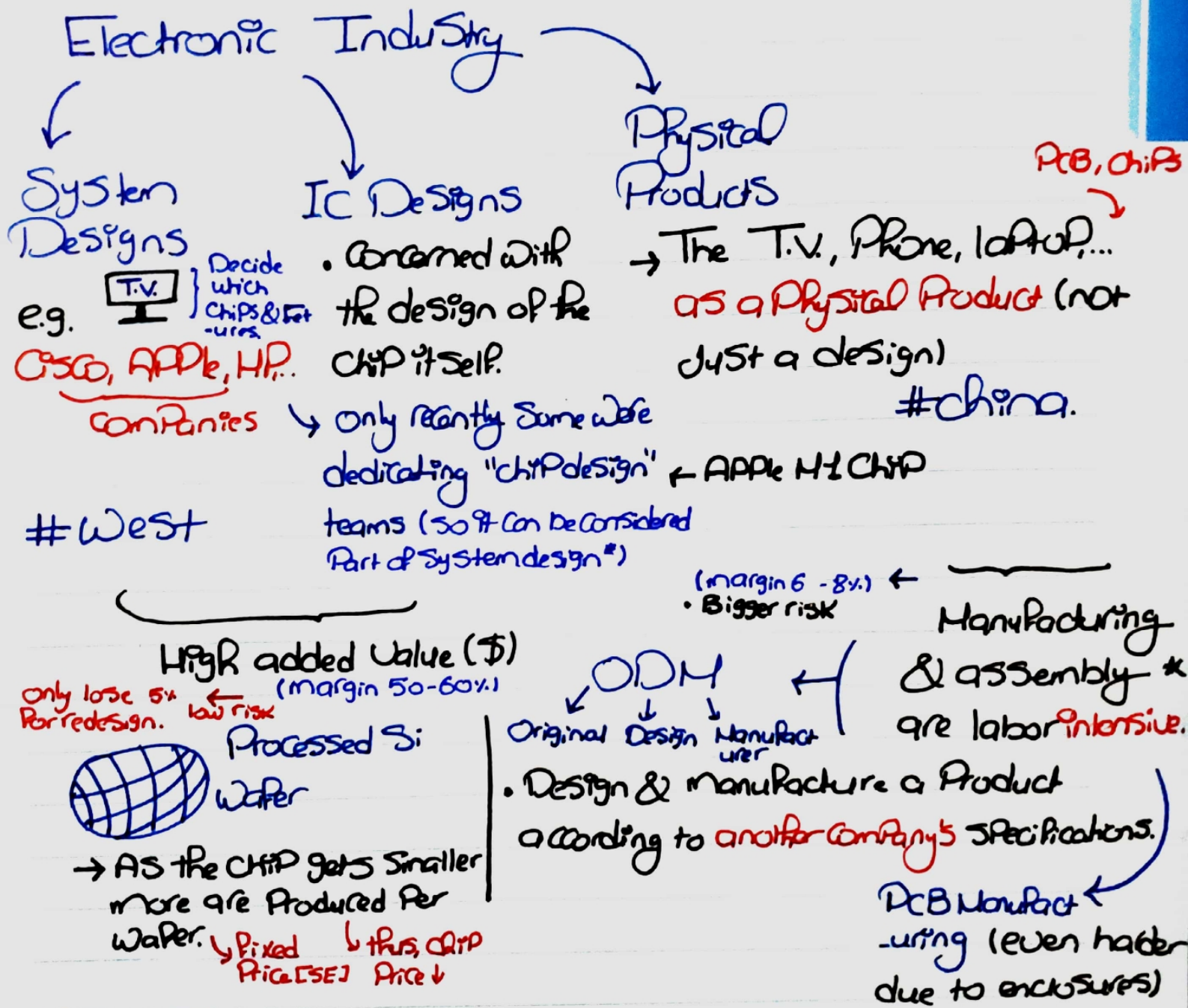
Requirements  
VHDL Code  $\rightarrow$   
 $\rightarrow$  Circuit  
// Our Focus

e.g. ARM

Licenses its chip design to Qualcomm, Mediatek  
 $\rightarrow$  gets 1.25% of Sales as Profit



# Introduction to the Semiconductor Industry.



## Electronics TAM (Total Available Market)

Depends on

\$62T	\$10T	\$1000B	\$300B	\$4B
World GDP	Electronic Goods.	Semicond. Components (design, man.)	Electronic Design Automation	

# Electronics Industry Segments by end-user market.

- |                 |                 |   |
|-----------------|-----------------|---|
| • Computer      | } e.g. Phones   | * low margin (unless innovative) but fast design cycle. |
| • Consumer      |                 |   |
| • Communication |                 |   |
| • Industrial    | } Factory needs | * in-between.   |
| • Automotive    |                 |   |
| • Military      |                 |   |
- (includes medicine)
- \* Long design cycle (too much testing) with low volumes but great margins (90% - 100% as you wish)

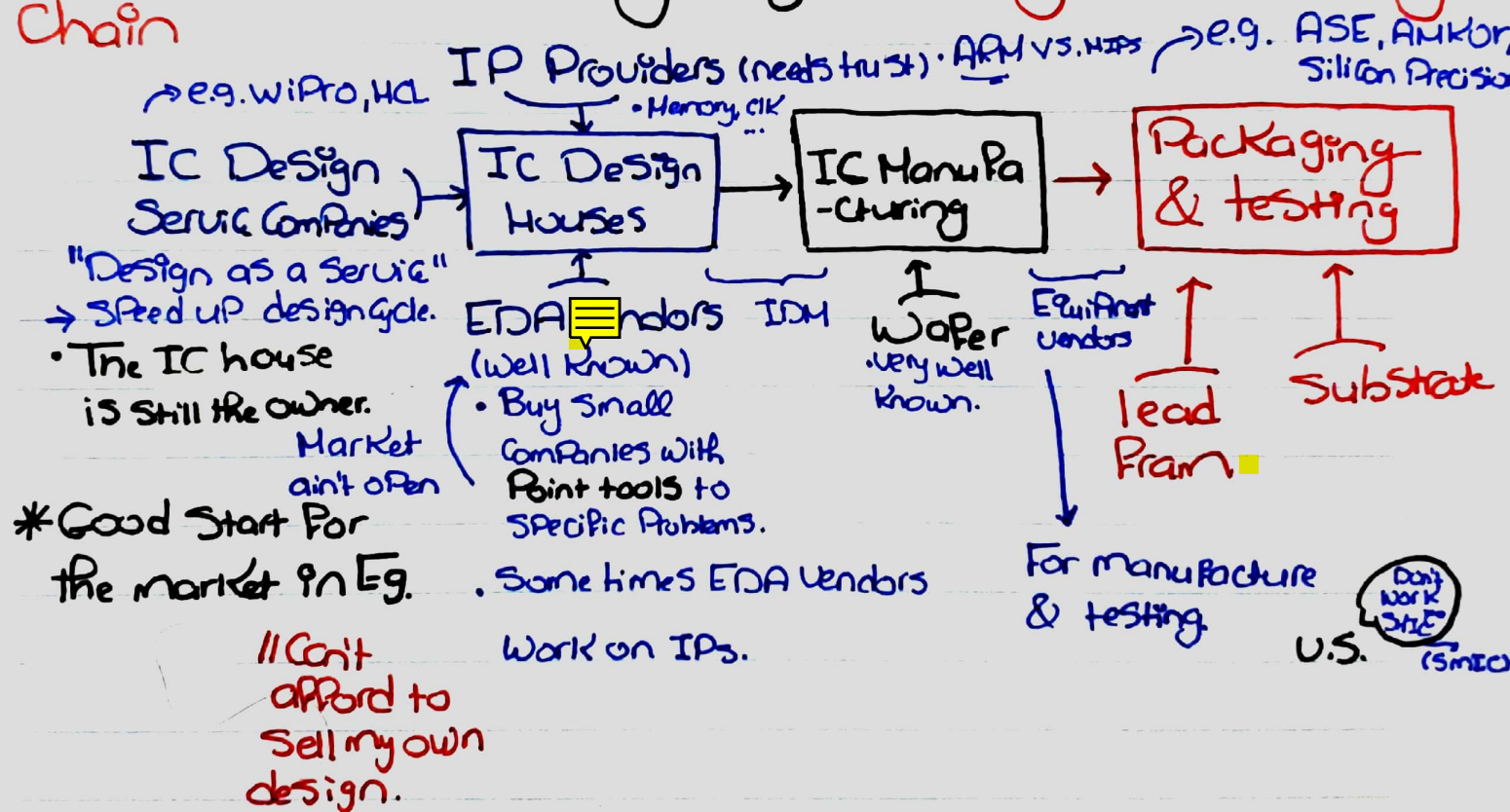
# Semiconductor Industry Segments by business model

- |  |  |  |
|--|--|--|
| <b>Fabless</b><br>(Design Only)<br>• Focuses on IP<br>Patents & licensing<br>e.g. Qualcomm, mediatek, nVidia<br>why not manufacture? → lacks innovation /<br>→ No capacity for 24/7 new tech.<br>operation (full utilization isn't possible) | <b>Merchant Foundry</b><br>• Finds work from Fabless companies<br>e.g. TSMC, Global Foundries, SMIC<br>why not design? | <b>Integrated Device Manufacturer</b><br>• Vertical Integration:<br><div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">Design</div> <div style="margin: 0 5px;">↓</div> <div style="border: 1px solid black; padding: 2px;">Produce</div> </div> e.g. Samsung Semiconductors, Intel, Toshiba, Mitsubishi.<br><b>Texas Instruments (TI)</b><br>Sold its foundries recently. |
|--|--|--|



- GF (Global Foundries) is a merchant foundry owned by a U.A.E. Company. ← Bought AMD's Fab before AMD went fabless.\*
- SMIC is the largest foundry in China.
- TowerJazz (Israel)
- X-Fab (Specialized)

## Semiconductor Industry Segments by Role in Supply Chain



• Cost of Sales → Cost to convince people to get & sell your product. (usually a lot)

TOP Semiconductor Sales Leaders → Intel, Samsung, TSMC, Qualcomm, Micron + Elpidia, SK Hynix, Toshiba, ... Memory ←