

VLSI Lecture 2

TOP Semiconductor growth leaders → MediaTek + MStar, SK Hynix, AMD, Micron + ElPida, Infineon, ...
(2013 - 2014) • Phenomenal 48% growth for MediaTek

... by Revenue → Intel, Samsung Electronics, Qualcomm, SK Hynix, Micron Tech, Texas Instruments, Toshiba, NXP, MediaTek.
U.S. Taiwan

Semiconductor Industry Segments

by business ✓

by supply chain ✓

by Product

• Discretes

→ Single Components (e.g. HT , LT , MR) ← Packaged

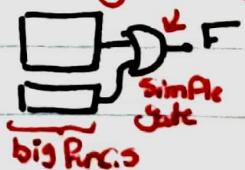
• Logic

→ Simple chips (e.g. containing a no. of a specific type of gates) 
the market for both here is pretty much mature.

→ an example of commodities.*

Used for "glue logic" ←

e.g.

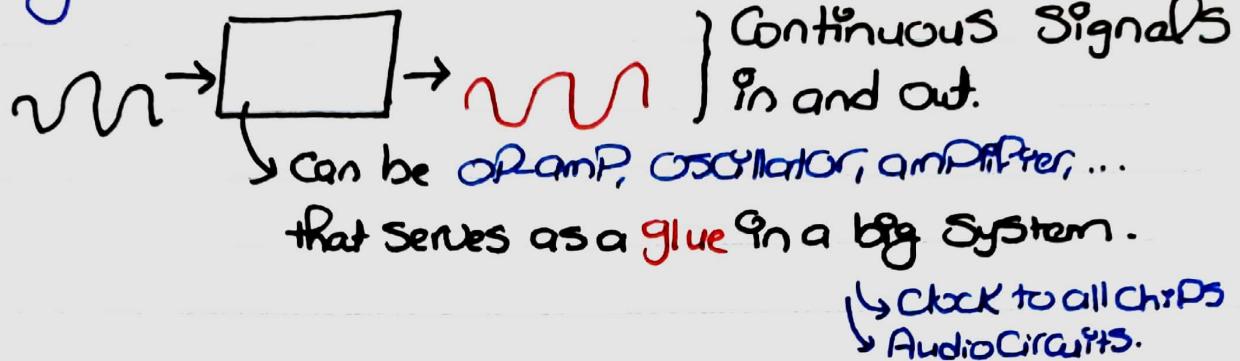


• Memories (DRAM, Flash, ...)

→ Companies: SK Hynix, Micron + ElP, ...

Hard to compete with unless you come up with an innovative technology ~ gives you an edge in price/density.

• Analog

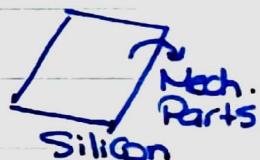


• Optoelectronics

e.g. laser diodes, LEDs, Photo detectors, ...

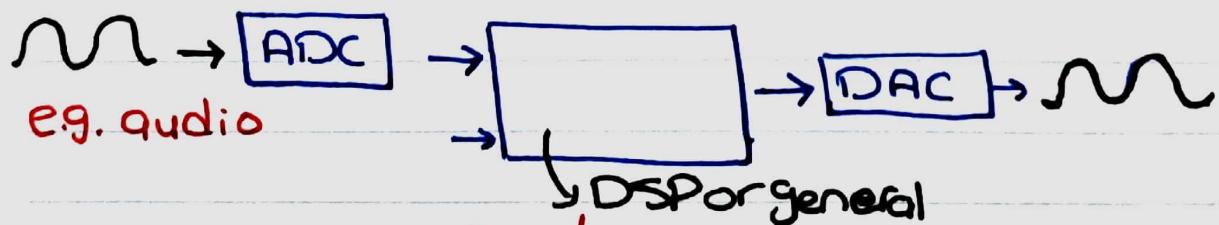
• Sensors / MEMS

↳ Micro-electromechanical Systems
. usually used with sensors



• DSP (Digital Signal Processing)

↳ requires a specific digital Signal Processor



expected to deal with ↳ Purpose Processor.

the input as a stream } e.g. for echo cancellation
(realtime.) } in calls

* go > along the one you know about is from T I.

* There is also an Israeli Company called Sheba (**)
(ignore this)
Microcontroller

• MicroControllers

- Unlike microprocessors, they target **specific specific** applications. (IOT, Control, ...)
- Very humble specifications. Comes with needed Peripherals

①

e.g. Atmel, ARM M, ...

• MicroProcessors

- ①, the boundary is some - what fuzzy now the less.

RISC CISC

ARM, MIPS Intel, AMD

• FPGA (Field Programmable Gate array)

In the Field
(Consumer II size)

- as many times as you wish.
- Due to Programmability it's not optimized in terms of area, speed, ...

↳ so that F= is achieved.
Programmable as hardware, yes.

• CPLD (Complex Programmable Logic device)

- Smaller scale & in some ways diff. from FPGA.

↳ non-volatile ↳ volatile

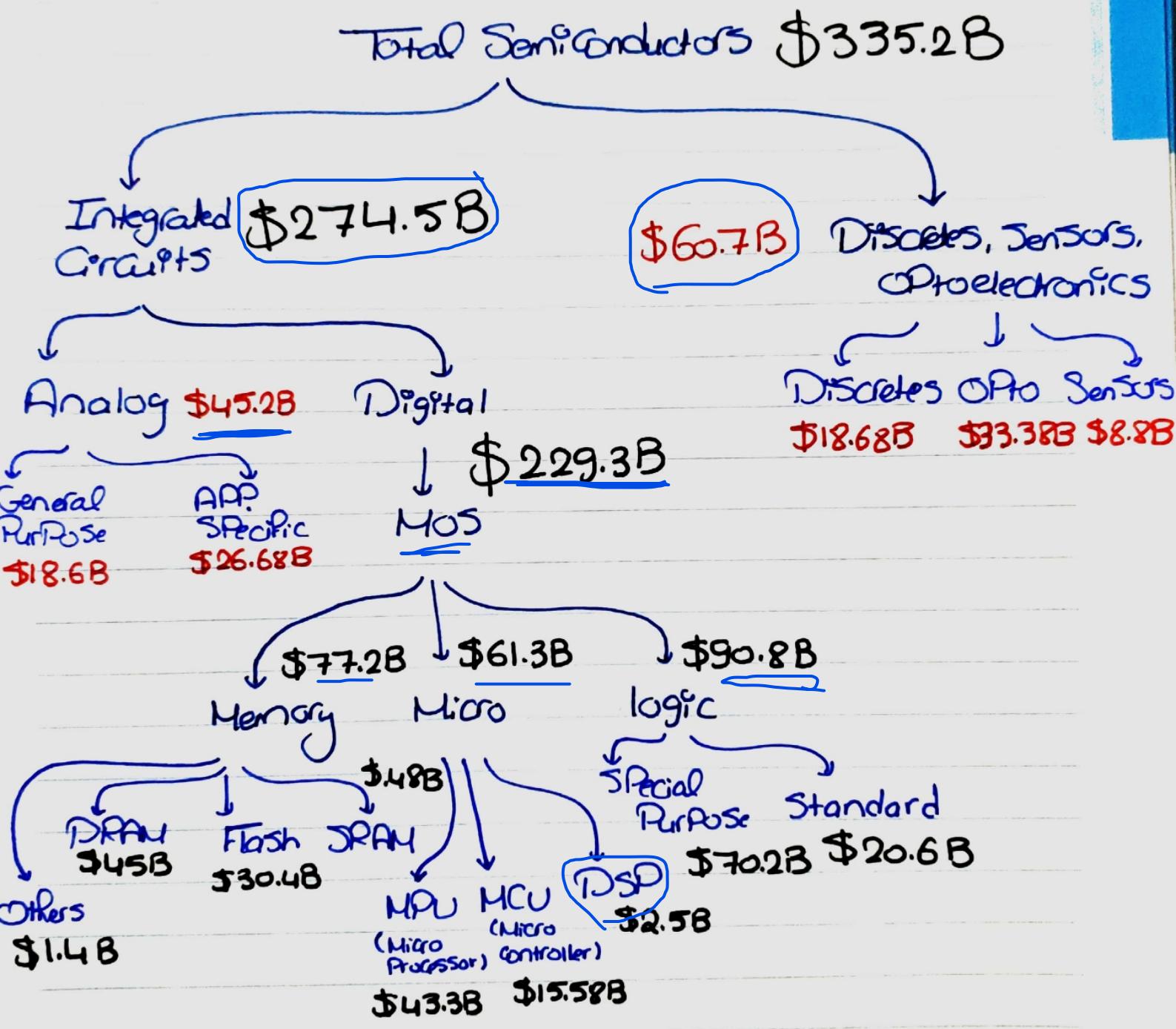
• ASIC (Application Specific Integrated Circuit)

- Designed as per requirements for some application but may in some cases be marketed to become a standard product.

// ASSP

(Application Specific Standard Product)

Semiconductor Industry Segments by Product #2015



→ Semiconductor Industry in Egypt

- Big Competition, Shouldn't Risk Starting unless its for a strategic objective. (e.g. need ICs for aeroplanes in case of deprivation)

• Consider Intellectual Property:

→ Need to be close to the market.

- How India/China did it? "Come back, tell us about the market, live a great life" ↳ to aliens (natives outside)

• Design Services

(e.g. ASIC, ASSP)

→ great option, comes with free marketing & technical experience.

... eventually (once acquired enough experience) can have my own product / IP. + Close to market

↳ Revenue has been ↑

As a Software engineer

→ Considering HW jobs can be risky.
but

• there's a big market outside Egypt.

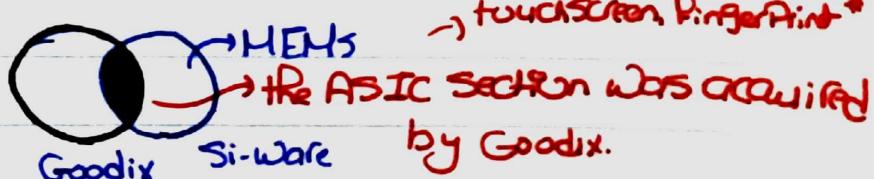
• Salary / growth can be better than SW.

Actual Industries in Egypt:

• Mentor Graphics

• Goodix (Chinese)

• Si-Ware (100% Egyptian)



• Si-Vision (Egyptian)

* Good bluetooth innovation.

* Agreed to work only for Synopsys according to a contract* (license).

- Hittite (got acquired by ADI)
 - ↳ Analog, RF
- IcePoda (used to be Swifttronix) "Memory for Synthesis"
- MyPex (chips related to video interfaces)
- Pearl (Timing chips, Si-Ware Systems spin-off)
- NewPort Media (Acquired by Atmel then no longer in Egypt)
 - ↳ DUD Standards
- SysD Soft (Acquired by Intel-Siemens then no longer in Egypt)
 - ↳ good LTE tech.

Other Related Companies

- PCB (Manufacture & Assembly)
- Samsung, Al-Araby, AOI, Al-Sweidy
 - ↳ Making electricity meters
 - ↳ Was even able to acquire small European companies.

\downarrow TVs
 \downarrow \$800M (Suez Canal Inc.) $\frac{5}{5}$ Per year!

↳ licenses designs from Toshiba (used to now, buys the entire design from China) (e.g. Tornado)

It's in Beni Suef because it only needs technicians.

Electronic Manufacturing

- Samsung, LG

↳ Medical devices
 (ultra sound)
 #Design Only

↳ Bio-Business

↳ Automotive Components + HW*
 • Valco

• Morocco

ST-Microelectronics ← Almost the largest chip maker in Europe.
(sizeable operation)

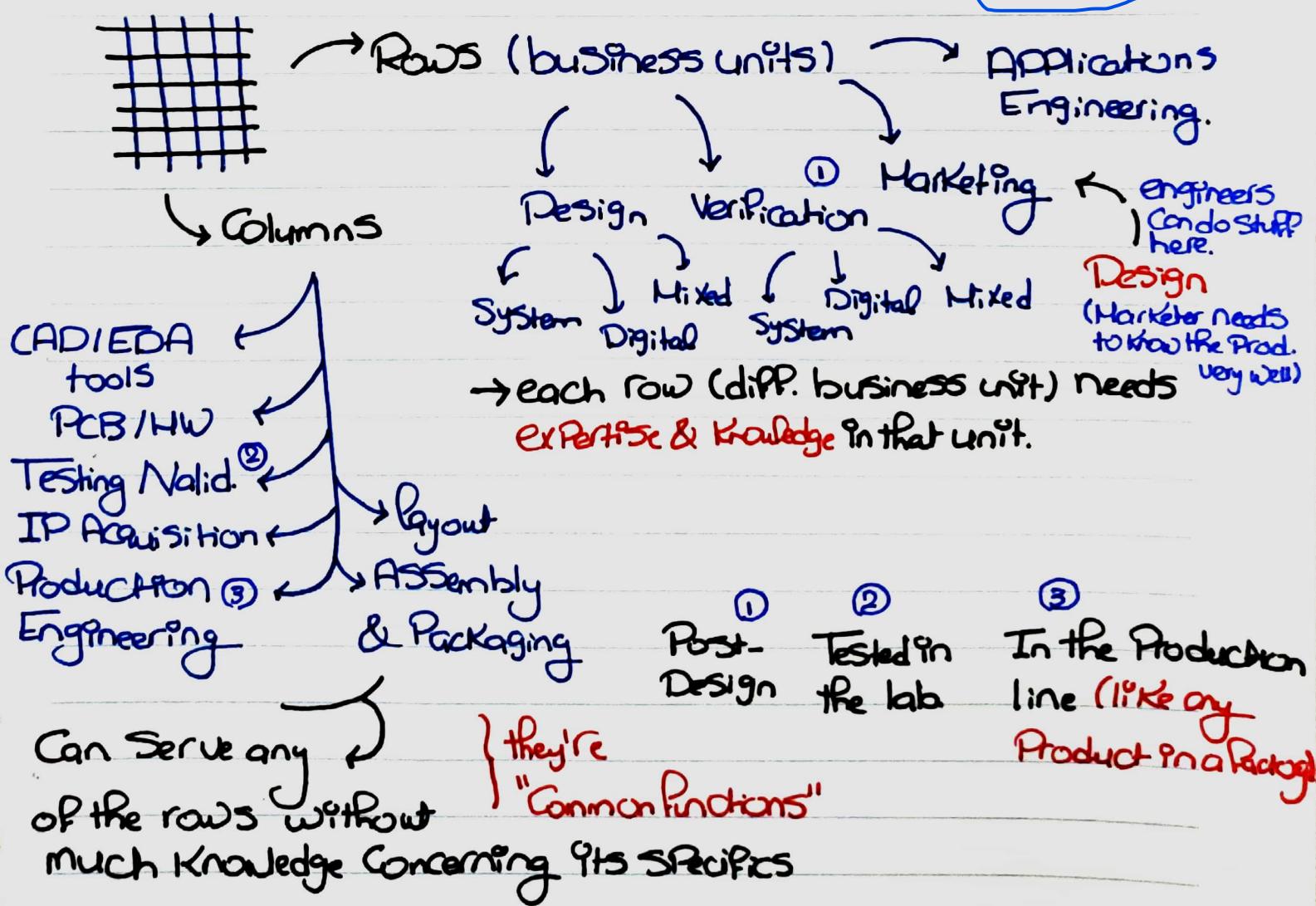
جهاز معمول

• Saudi & UAE → sizeable research activities

Functional Structure of a Fabless Company

It's a matrix organization

↳ No need to focus
on product development as
opposed to owning the fab.



<Video>

Intel's FAB 32 in Arizona

* Clean Room

①

11 Floors

Responsible for air filtration (For the two lower floors) → Pressurized Plenum

Chemicals & gas for clean room → Clean Subfab

Electrical & other systems → Utility level

↳ Has no columns
For easier distribution.

① Filtration:

→ Even the smallest particles can contaminate the entire chip.

How small?

Hair → 75-100 Micron (μm)

Smallest eyes can see → 40-50 Micron

Filtration → 0.5 Microns

too small

* The lab uses 45 nm technology

45 nm

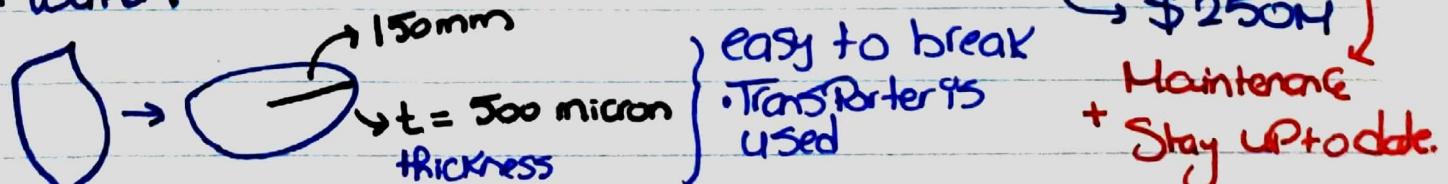
• It's also the channel width.

↗ If the tech. was better (smaller λ)
we would need a better filter.

. It operates 365/24/7 (Shift $\xrightarrow{\text{Shift}}$ Shift)

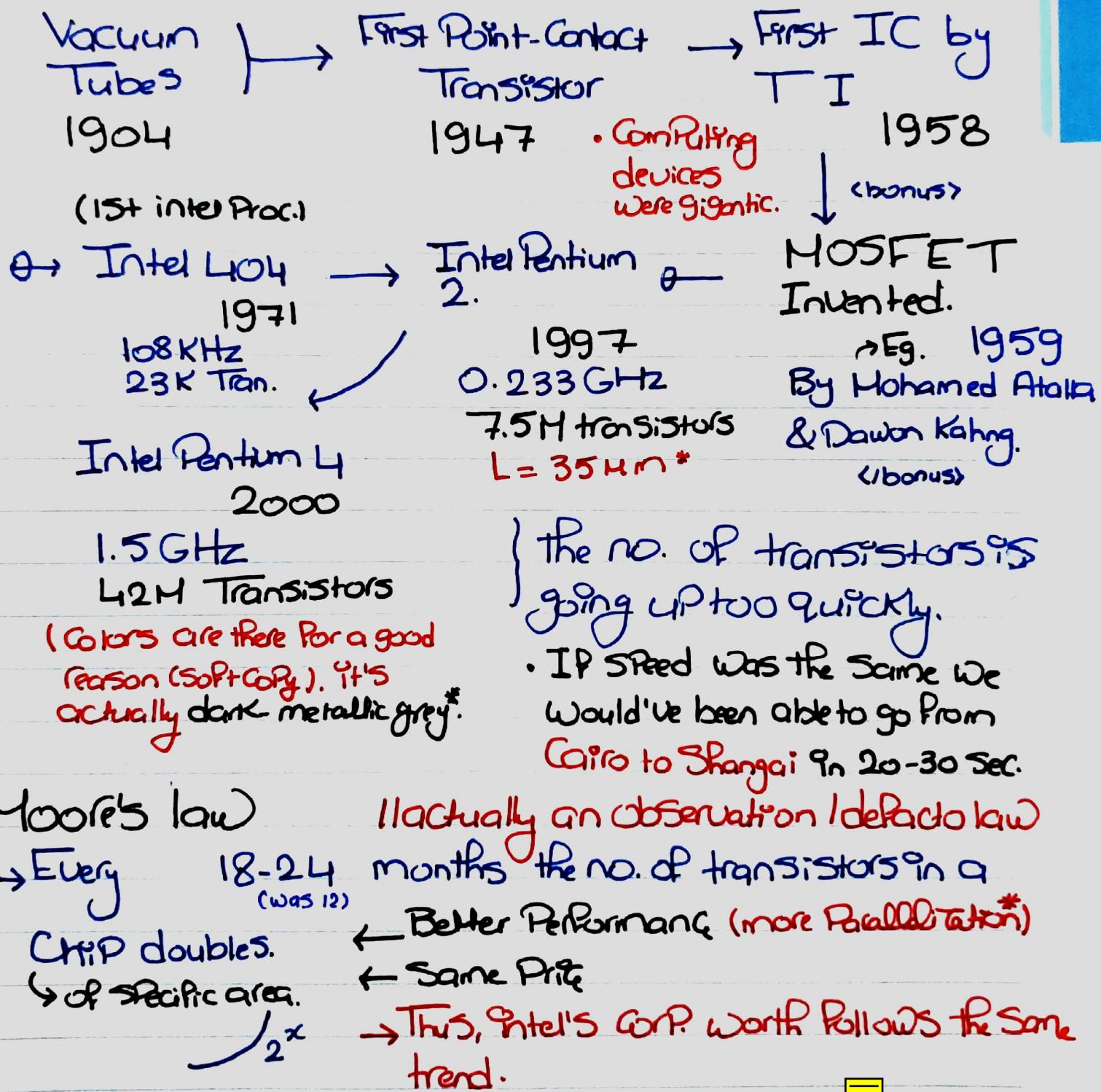
. Took \$3B to build and requires yearly tooling.

Si Wafer:



</Video>

Technology Trends



*The graph may look linear if the vertical access is logarithmic

- Cost Per Component VS. no. of Components in a Circuit

1965 1970 Smaller Cost Per Component at most no. of Components.

→ can't optimize further.