

Motorola DynaTAC 8000X, 1983



By Redrum0486 -
<http://en.wikipedia.org/wiki/File:DynaTAC8000X.jpg>, CC BY-SA 3.0,
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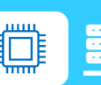
Motorola StarTAC, 1996



By 80sCompaqPC - Own work, CC BY-SA 4.0,
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5G
3G4G

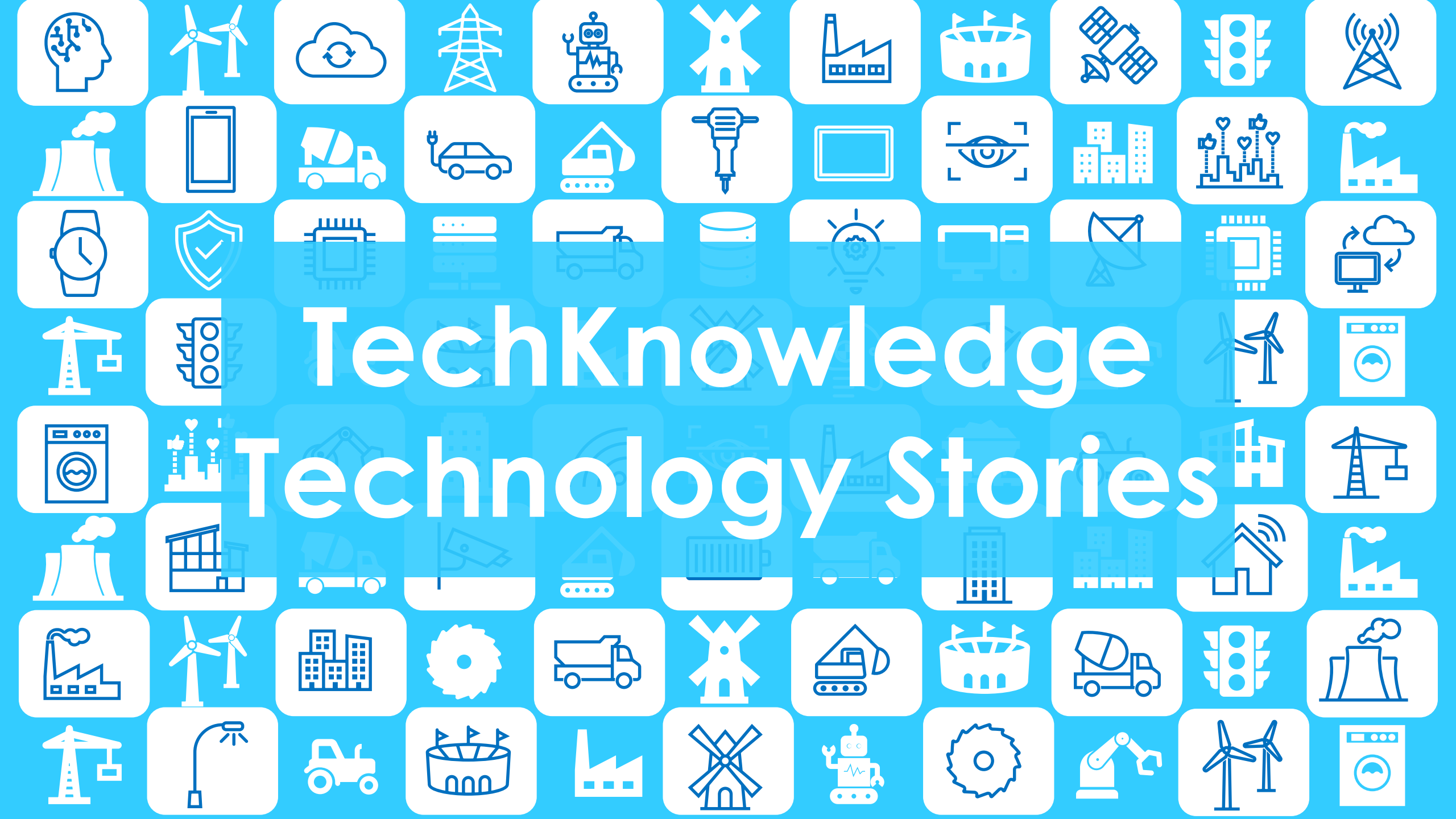


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Apple iPhone 15, 2023



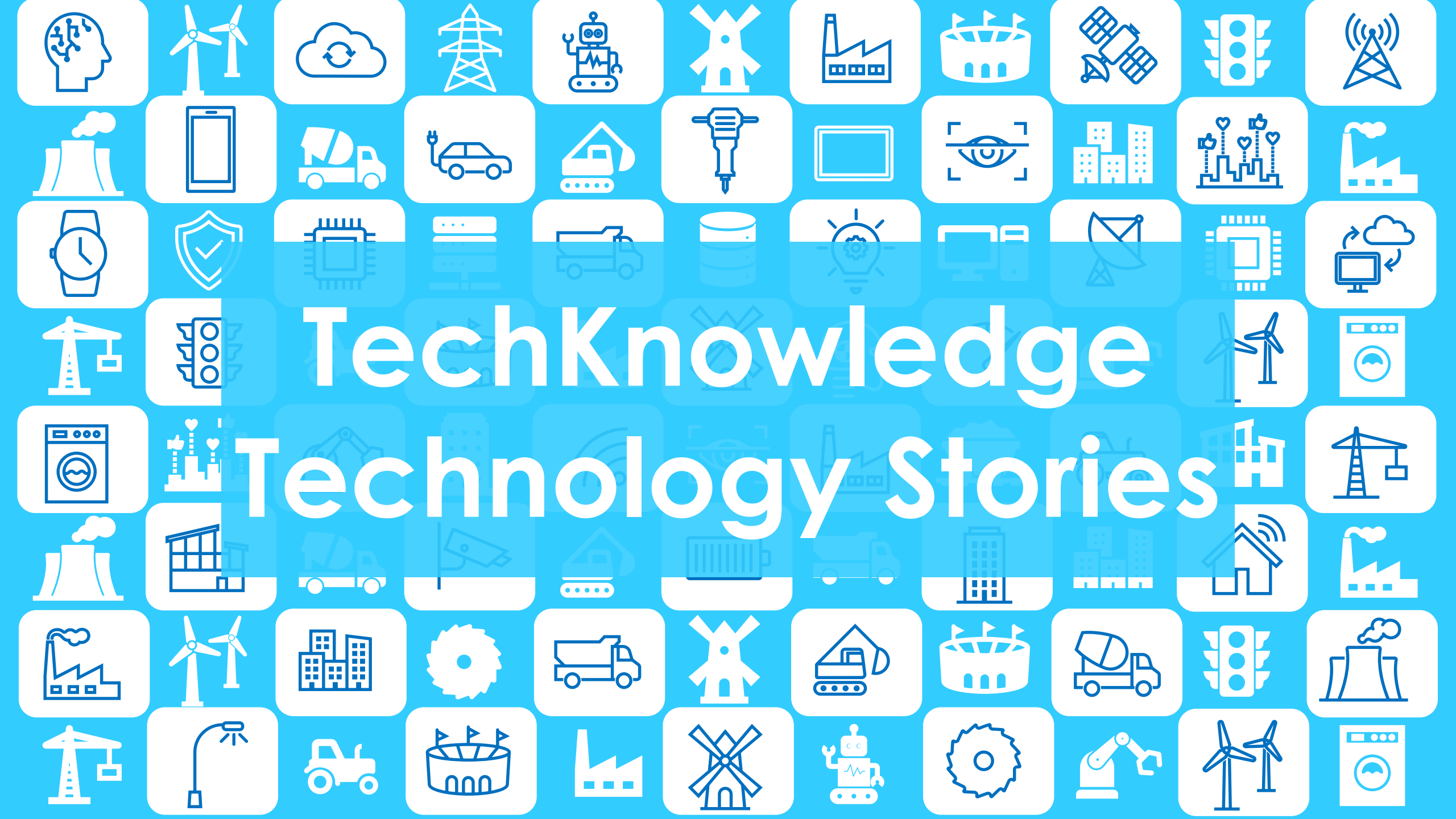


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Part 1: Smaller, Faster, Cheaper and More...

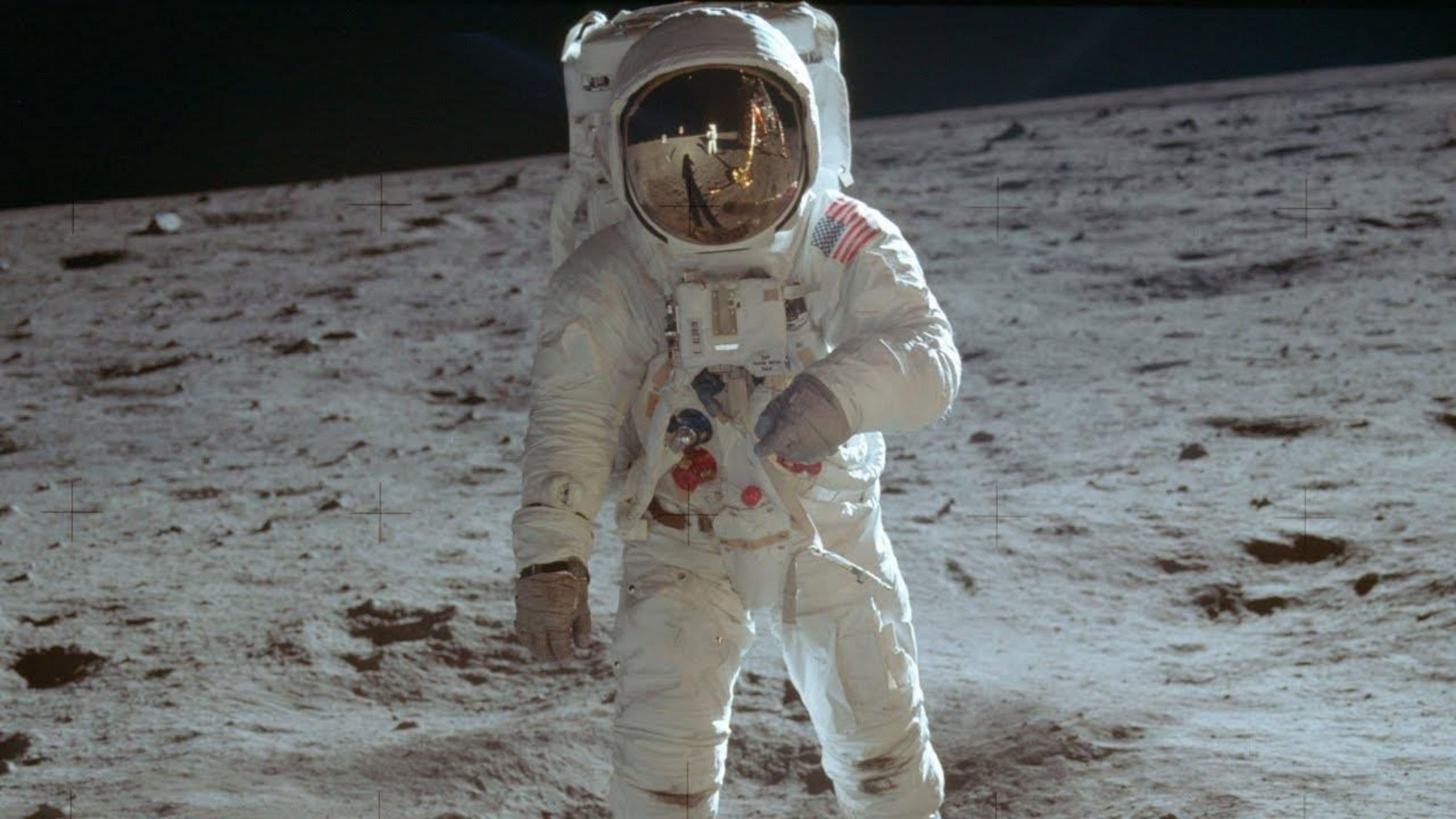
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 Student / Intern



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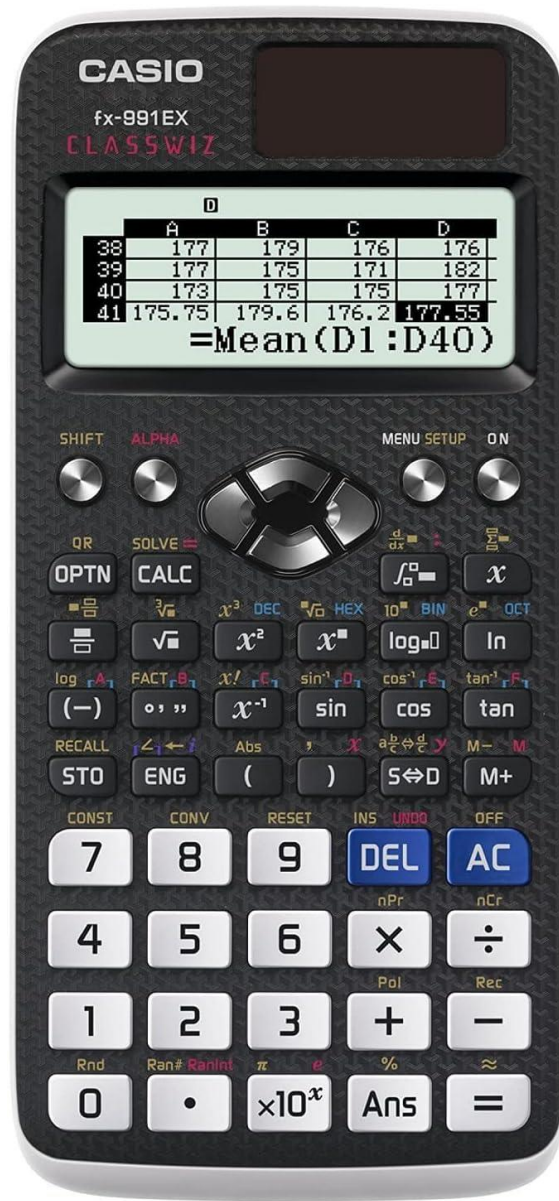


This is Margaret Hamilton,
the computer scientist and
systems engineer who led the
team that wrote the software
code for the Apollo 11
mission.

Her code saved the mission
when it nearly had to be
aborted.

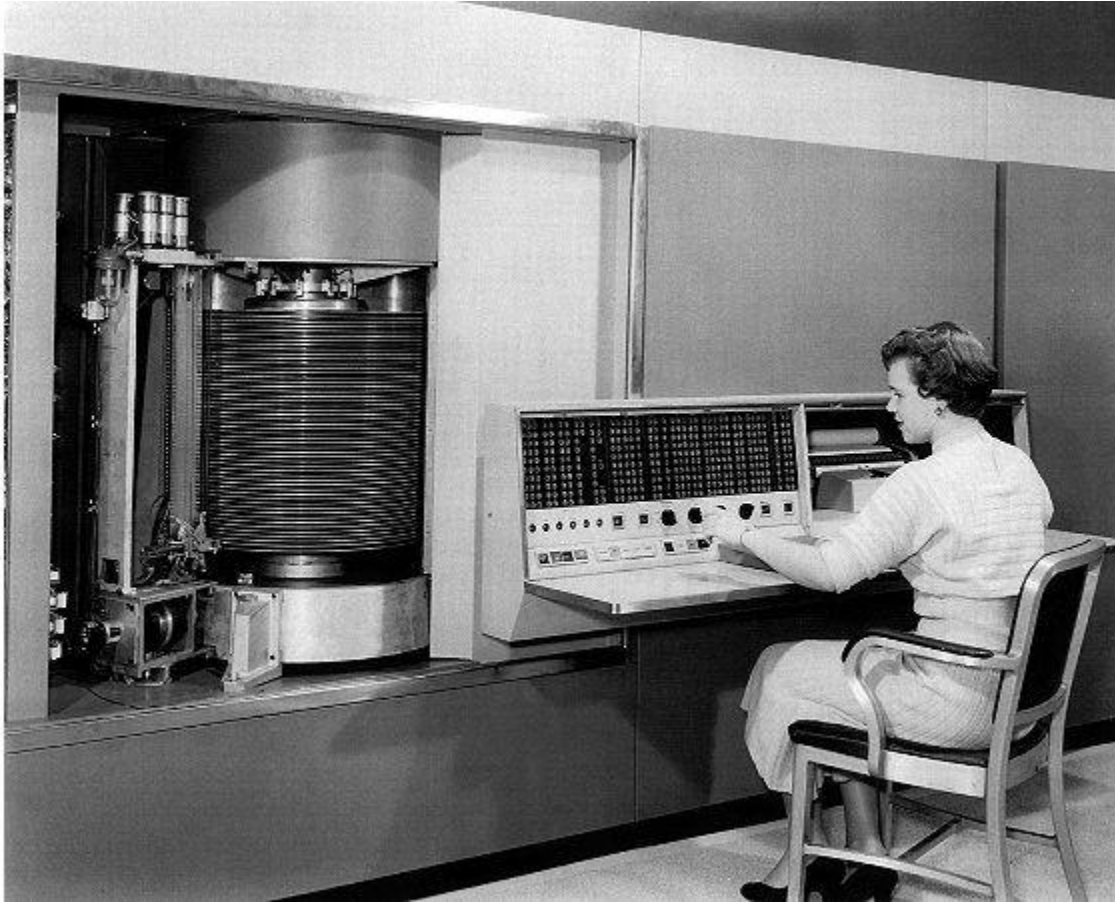
Without Margaret Hamilton,
we would never have
reached the moon.





Google Pixel/Pixel XL 3 Pin UK Mains Charger 18W
USB Power Adaptor with Power Delivery





This is a picture of IBM 350, the first hard disk in history with storage capacity of nearly 5 MB



Can Less = More?

Technological advances made since the first hard disk was developed in 1956 mean that more and more storage takes up less and less physical space.

How small can it get?



1959 36" Disk Platter
Capacity: 1MB

1972 24" Disk Platter
Capacity: 23MB

1976 14" Disk Platter
Capacity: 5MB

1984 8" Disk Platter
Capacity: 5MB

1996 5.25" Disk Platter
Capacity: 120MB

2006 3.5" Disk Platter
Capacity: 80GB

2016 Average 3.5" Hard Disk
Capacity: 200GB (7B)

2016 Average 3.5" Hard Disk
Capacity: 200GB (7B)

"There is no thrill like that felt by the inventor as they see their creation unfolding to success ... such emotions make a person forget food, sleep, friends, love, everything."

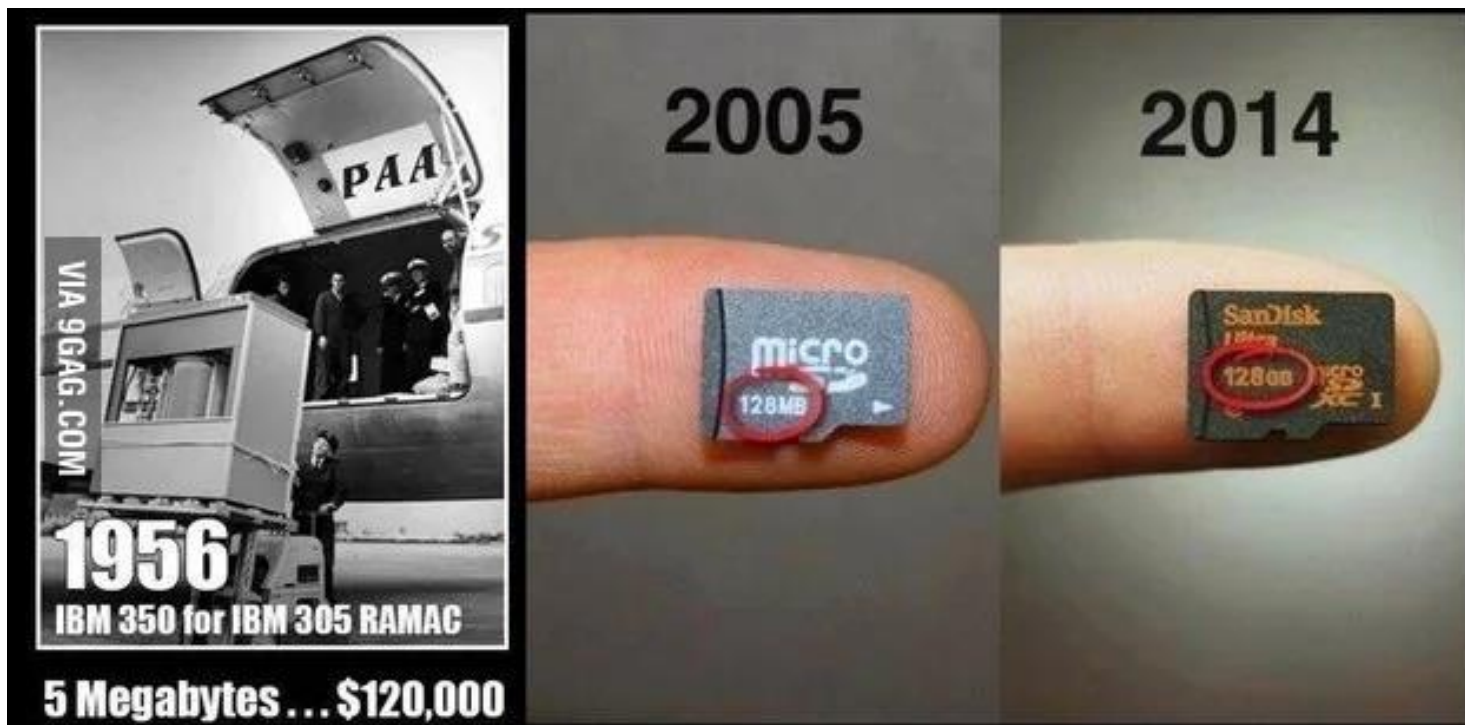
Nikola Tesla, Inventor and Engineer



@computermuseum



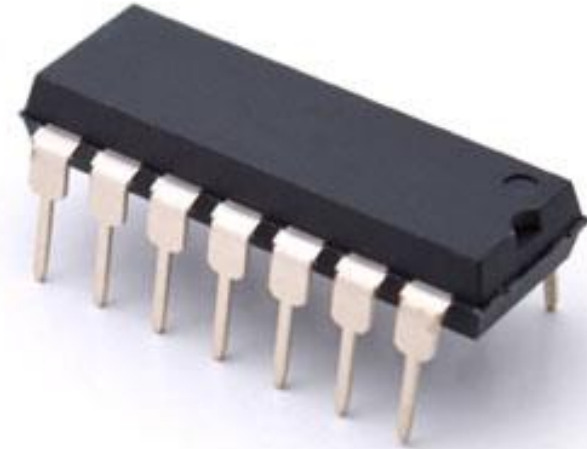
/computinghistory





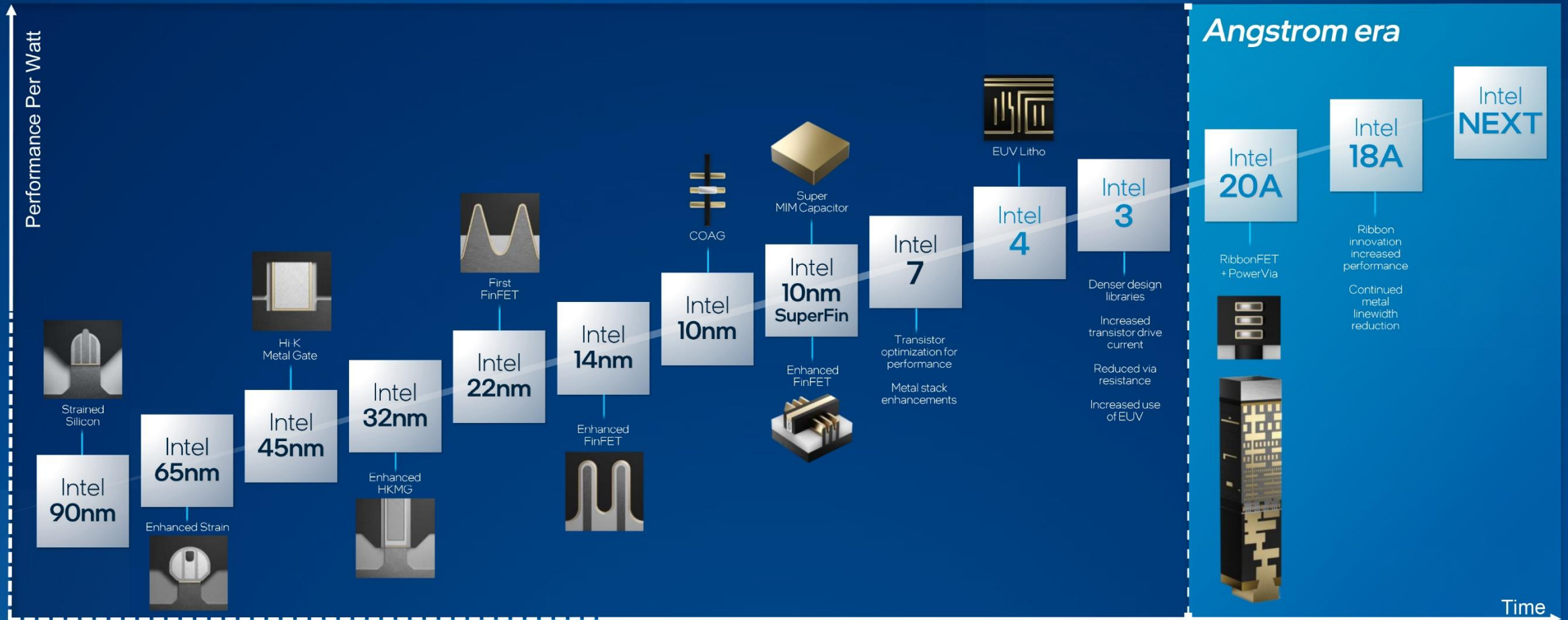
Vacuum tubes: slow, expensive, fragile

Transistors: much simpler, much smaller, much cheaper, more reliable, no warm up, much faster.



Integrated circuits: miniaturization added to all the existing benefits, enabled unthought-of possibilities

Intel Process Technology



Every major transistor innovation in the past 20 years delivered by Intel
and we are driving the next with RibbonFet & PowerVia

This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

50,000,000,000



Year in which the microchip was first introduced

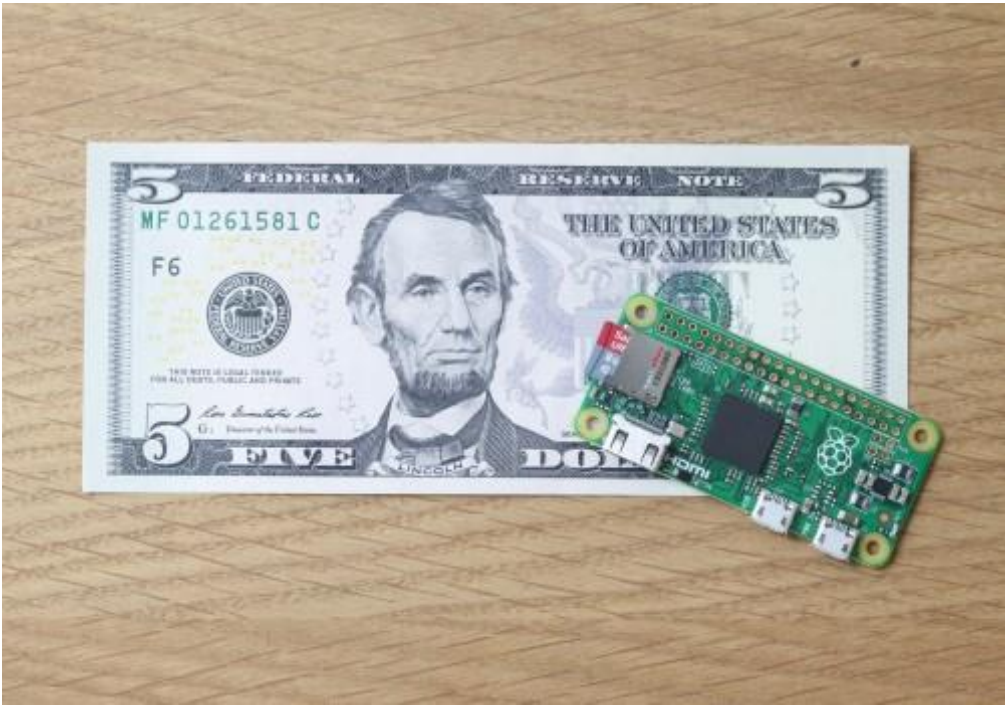
OurWorldinData.org – Research and data to make progress against the world's largest problems.

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Elliott 405: Norwich City Council, England, receiving its first computer in 1957



Raspberry Pi Zero, 2015



Measure	Elliott 405	Raspberry Pi Zero
Price	£85,000 (in 1957)	\$5
Weight	3-6 tons	0.31 ounces (9 grams)
CPU Instruction cycle time	10.71-0.918 ms (93-1089 Hz)	1 ns (1 GHz clock)
Main memory	16 kB drum store	512 MB LPDDR2 SDRAM
Fast memory	1280 bytes (nickel delay lines)	32 kB (16 kB I + 16kB D L1 cache)
Secondary memory	1.2 MB (300,000 word magnetic film)	8 GB (typical micro SD flash card - not included)
Output bandwidth	25 characters/s	373 MB/s (1080p60 HDMI)



PowerBook 500 on the left, released in 1994. MacBook Pro 2019 on the right.



Power up —

From space landings
to supercomputers
to smartphones

Apollo 11
Guidance Computer



12,250 FLOPS*

CRAY-2
1980s Supercomputer



1.9 billion FLOPS*

Approximately
155,000 times faster
than the Apollo 11
guidance computer

Apple iPhone 12
Smartphone



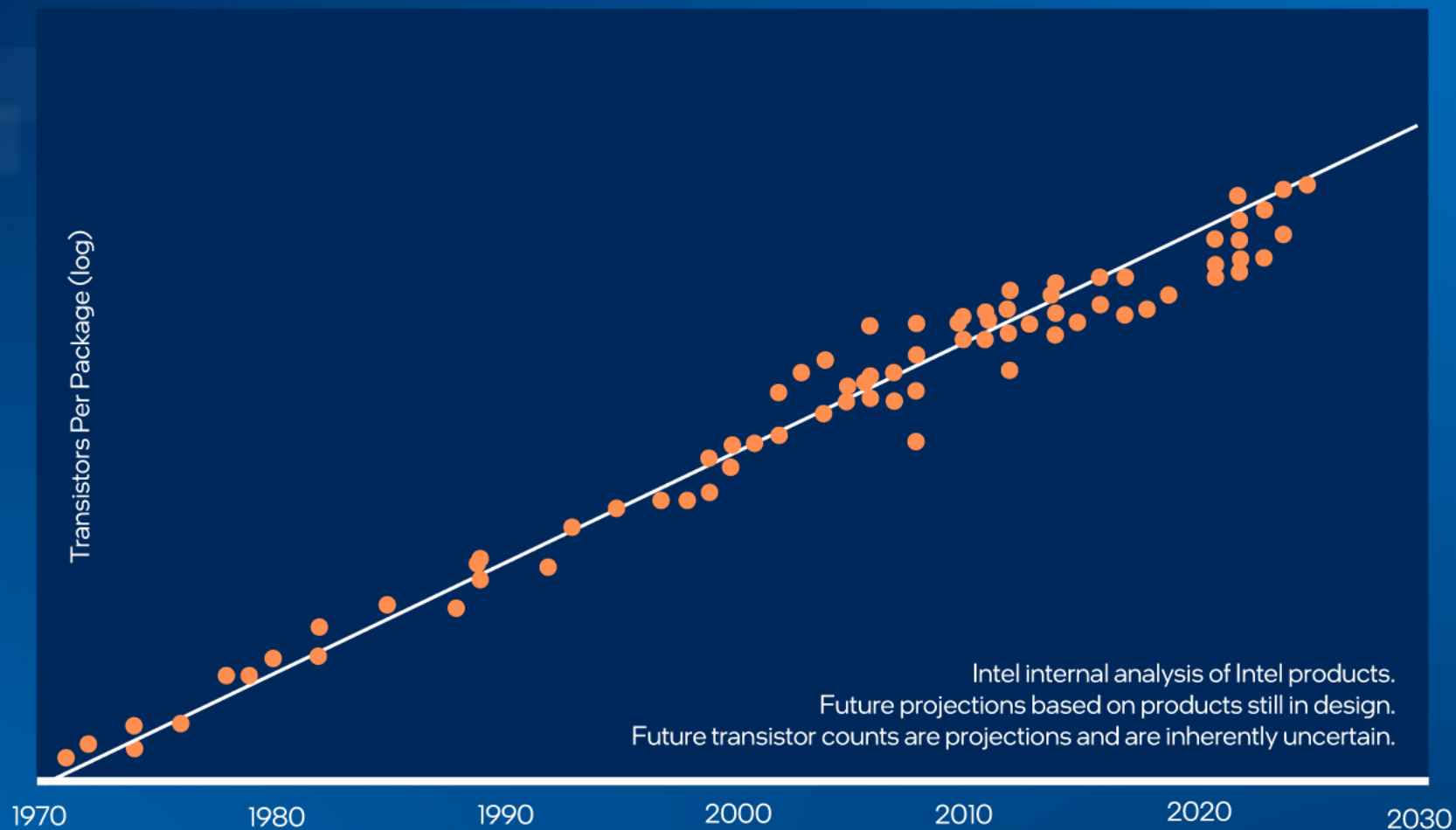
11 trillion FLOPS*

Approximately **5,000 times faster**
than the CRAY-2 supercomputer
and about **900 million times**
faster than the Apollo 11
guidance computer.

FLOPS: floating point operations per second

Source: PCMag





Aspiring to
1 Trillion
transistors in 2030

- ✓ RibbonFET
- ✓ PowerVia
- ✓ High NA
- ✓ 2.5D/3D packaging



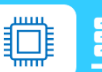
Apple Vision Pro, 2023



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References and Further Reading

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- Wikipedia: Motorola DynaTAC ([link](#)), Motorola StarTAC ([link](#))
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- Intel Video: Evolution of Transistor Innovation ([video](#))
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- Diomidis Spinellis blog: Raspberry Pi Zero vs Elliott 405 ([link](#))
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- PCMag - Space Wars: 80s CRAY-2 Supercomputer vs. Modern-Day iPhone
- Apple: Apple unveils iPhone 15 Pro and iPhone 15 Pro Max ([link](#))
- Apple: Introducing Apple Vision Pro: Apple's first spatial computer ([link](#))



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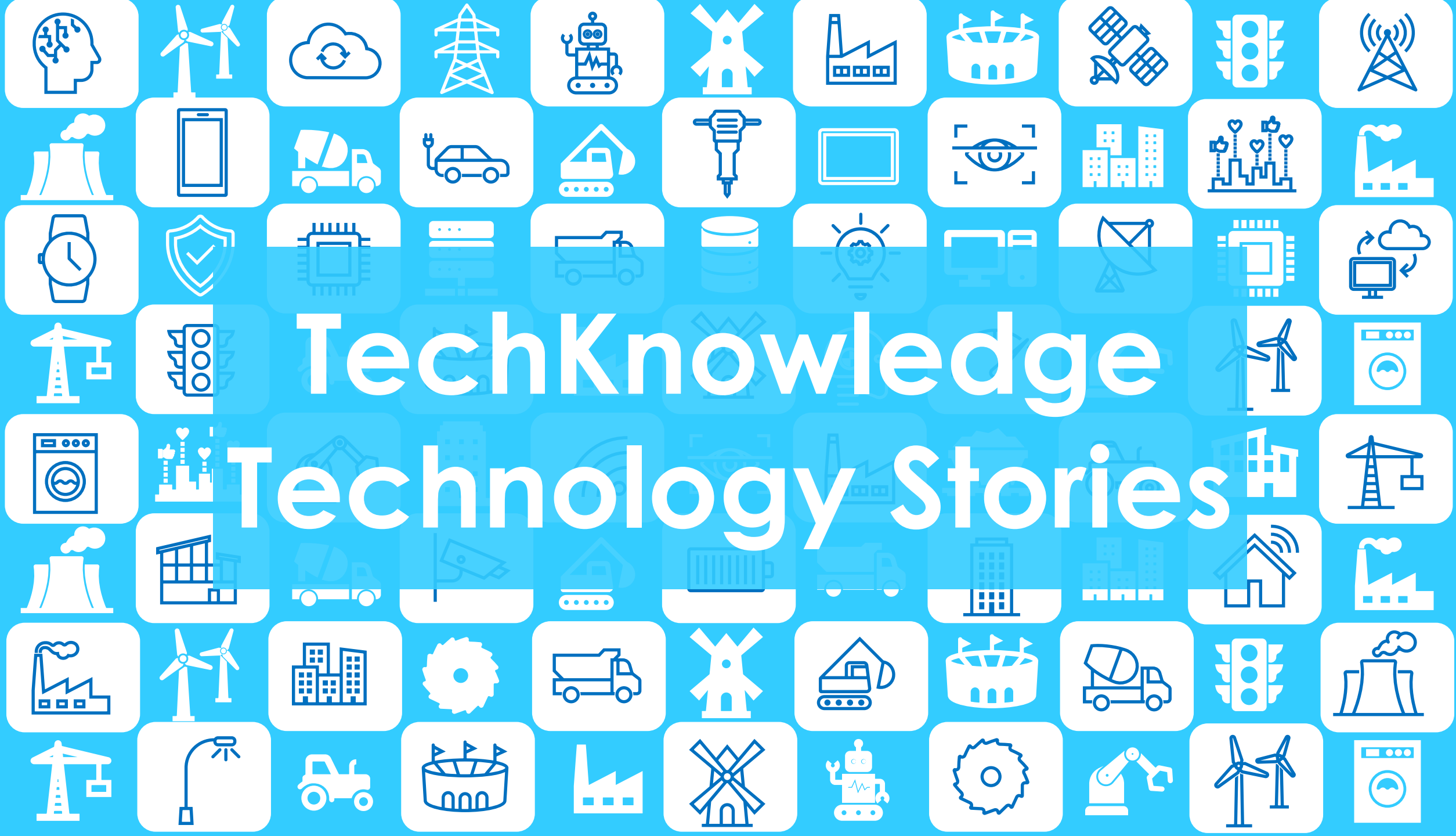
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