

Semiconductor Industry Reflections over 6 Decades

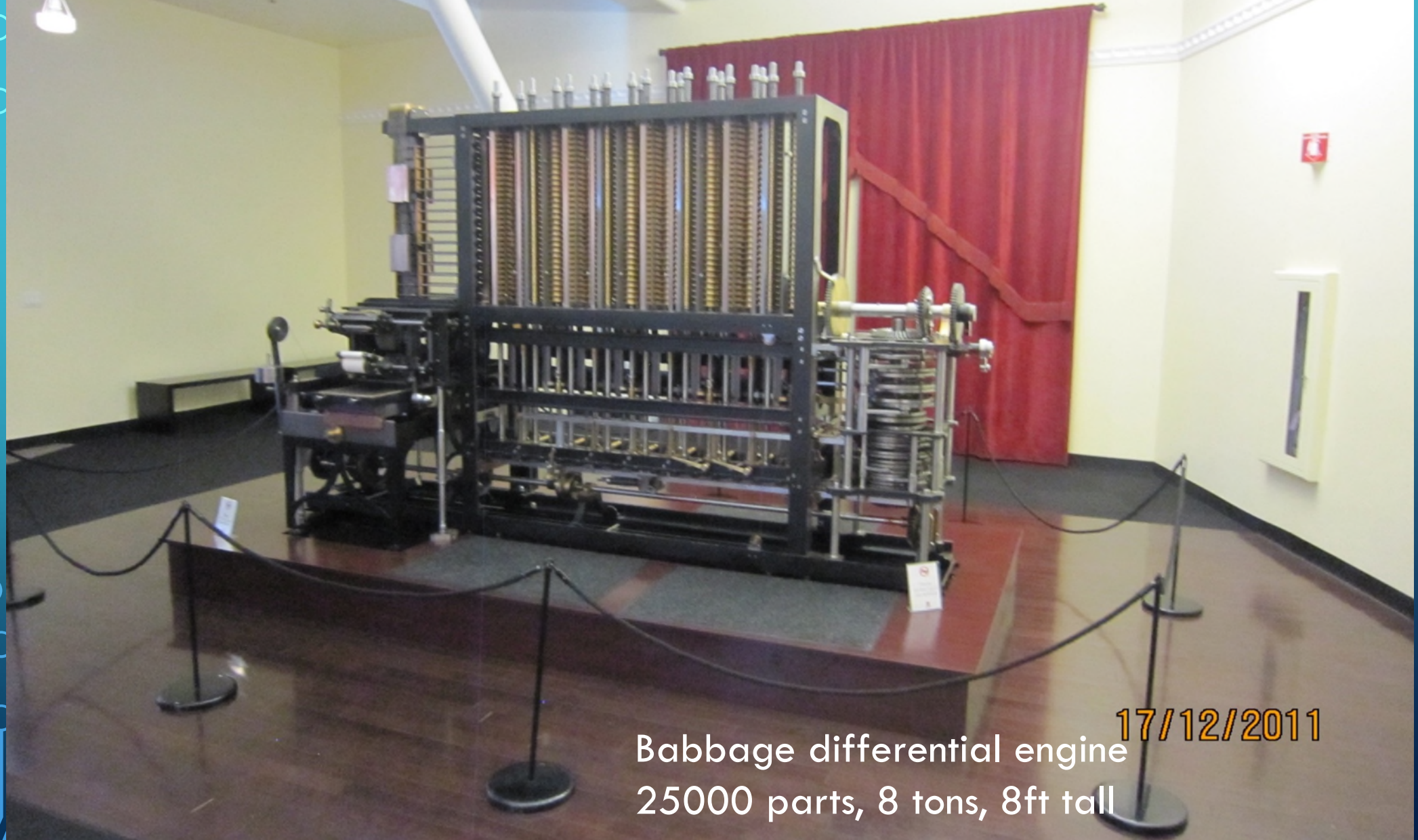
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Veijo Kontas OH6KN / OH8X



Semiconductor Industry Reflections over 6 Decades

- Computing 150 years ago
- The Dawn of the Chips in the 70s
- Chip complexity grows significantly with the PCs in the 80s
- The mobiles drive the industry 90s
- Internet comes to every pocket in 2000s
- Mobility as lifestyle in 2010s
- Moving fast forward in 2020s
- Things to watch out

COMPUTING IS MUCH OLDER THAN WE THINK

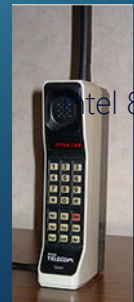
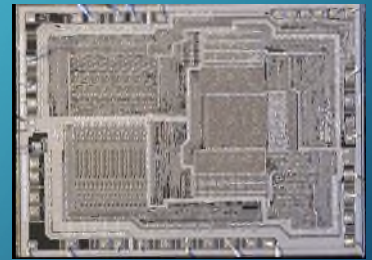


Babbage differential engine
25000 parts, 8 tons, 8ft tall

17/12/2011

The dawn of the chips in the 70s

- In the early 70s lots of equipment was still based on tubes, e.g. color TVs
- Digital design was based on simple 7400 TTL logic chips (gates, FF, counters)
- Analog design using mainly discrete components
- Analog computing was quite popular due to lack of small scale computing
- The first microprocessors changed the game in mid 70s
 - Reasonably priced general purpose programmable devices
 - Intel 4004/8008/8080/8085, Mostek 6502 (3ktr, 8um), Motorola 6800, Zilog Z80
- First mobile phones
 - The first cellular phone demo – Motorola Dyna Tac in 1973
 - Commercial launch in 1983
- Amateur radios started to be mainly transistorized



Intel 8085 6.5ktr, 3um



Chip complexity grows significantly with the pcs in the 80s

- Intel 8088 was chosen for the first PCs, which changed the world of computing

- Intel 8088/8086 (5MHz, 3um, 29ktr)
- The start of x86 and Microsoft era
- At the end of 80s Intel Pentium 486 (50MHz, 1.2Mtr, 1um)



- Nokia started first chip designs for the NMT mobiles 2nd half 80s

- NMT commercialized in the 80s, 3GPP GSM in development

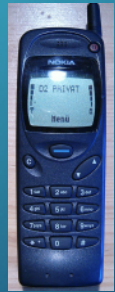
- Amateur radios were fully transistorized with chips

- PLL tuning, solid state PAs



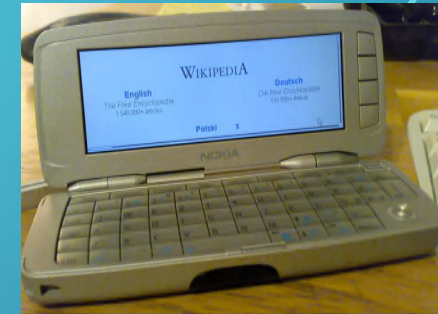
The mobiles drive the industry in the 90s

- GSM drove the development of digital phones in the early 90s
 - Pan European phones and partially world phones. US and Japan had domestic systems
- First phones were using discrete solutions with some custom SoCs
- Integration advanced fast – Nokia was leading in BB & RF integration
- Strong focus on energy efficiency – architecture, design, Si tech, SW
- Nokia became #1 around the turn of the century
- Technologies developed from ~500nm to ~180nm during the decade
- Pentium III ~600MHZ, 28Mtr at 180nm
- Amateur radios started to use high first IF, CAT control



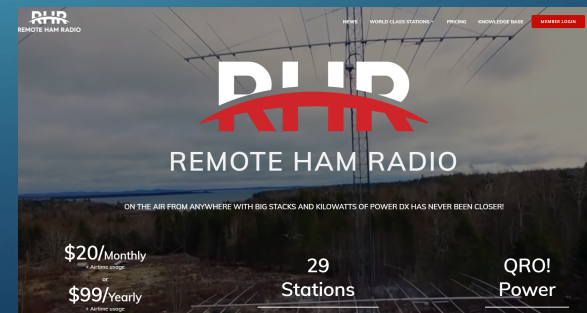
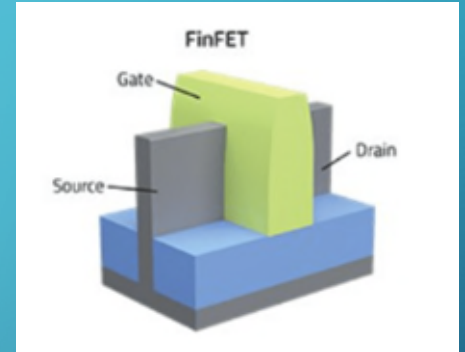
Internet comes to every pocket in the 2000s

- 3G and first early smart phones came to the market – first world phones
- 3G enabled good emailing, web browsing, later navigation and gaming
- Phones replaced the cameras, navigation replace maps, music became easy to consume, apps stores, wireless shopping
- In 2007 Apple exploded the bank and Android showed up
- Nokia peaked in business 2007, but didn't react to the changing world quickly enough
- Laptops became dominant PCs
- Intel 64 bit CPUs i3/i5/i7 (780Mtr), >3GHz, 45/32nm
- Amateur radios entered the SDR era – no return back



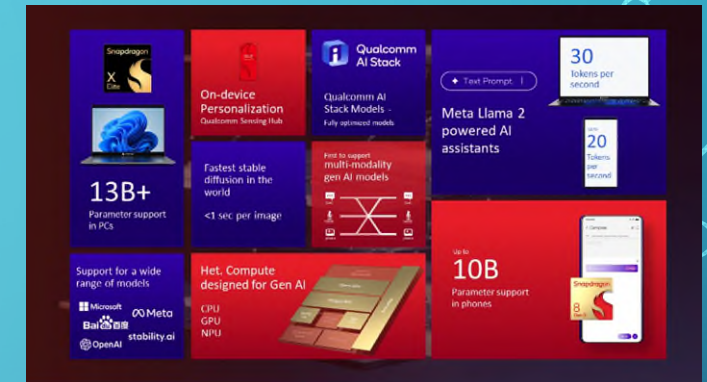
Mobility as lifestyle in the 2010s

- Smart phones became the main stream and affordable
- 4G/LTE enabled significant improvements for performance
- Real time gaming, video streaming, social media
- # of mobile chipset makers reduced significantly, Qcom, Mediatek, Samsung, Apple
- Nokia focused on wireless and wired networks
- Intel introduced Finfet at 22nm trigate in ~2012
- Intel Ice Lake 10th gen CPUs, 8Btr at 10nm
- Amateur radios entered remote era
- FT8 changed the game

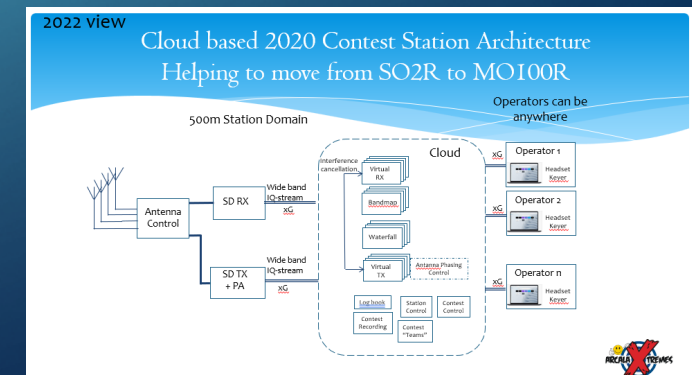
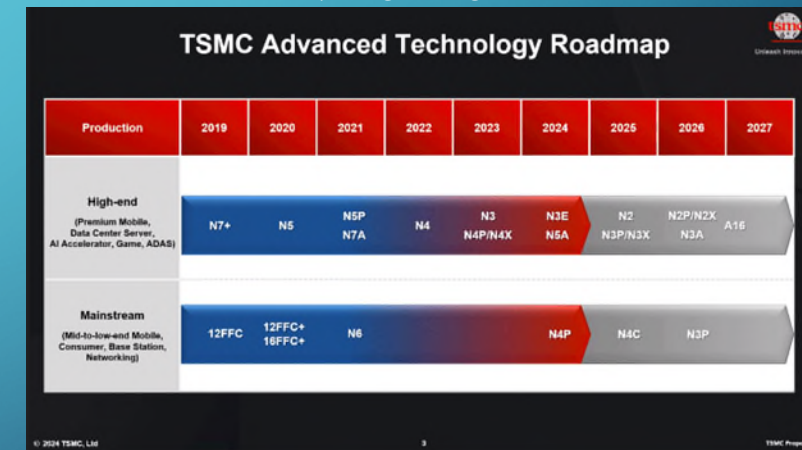


Moving fast forward in the 2020s

- 5G enabling lots of new use cases: autonomous driving, industry 4.0, automated ports, xR, etc.
- AI / ML driving the industry
- xR and AI coming to mobiles
- 6G will come to the market in 2029
 - Capacity, data rates, reliability, lower power, more bands
- 1 Ttr magic milestone at $\sim 1.4\text{Å}$ (1.4nm)
- Amateur radios to be cloudified
- Station automation fully based on Enet



Snapdragon 8 gen 3



Things to watch out

- The technical innovation resides much in the Silicon Valley – Europe must speed up
- AI will change ways of working drastically
- Huge portion of Si manufacturing in SE Asia under threatening circumstances
- Cost of SoC development exploding – re-use
- Amount of SW exploding
- Shortage of SoC designers
- Geopolitics driving for national/regional funding
- Finland to invest enough to research and talent education



What's Next ?

How do we, the radio pioneers continue to
ride on the technology frontiers ?

What's Next ?

There is lots of good stuff, but we need to
take them forward.

Remote, RIB, station automation, FTx, digital
speech, propagation topics, skimmer, SDR,
satellites, cloud, AI